Telephony.

AN ILLUSTRATED MONTHLY TELEPHONE JOURNAL

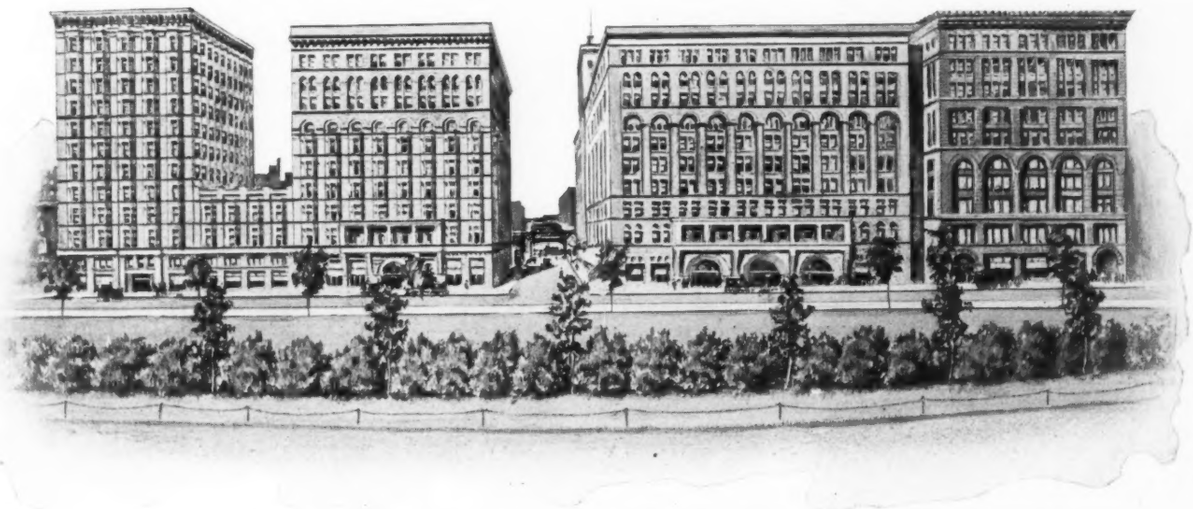
VOL. IV. CHICAGO, DECEMBER, 1902. No. 6.

Interstate Independent Telephone Association Convention.

The regular annual convention of the Interstate Independent Telephone Association will be held at the Auditorium Hotel, Chicago, on December 9, 10 and 11, 1902. From all indications this will be the largest telephone convention ever held. The complete program for the three days follows:

TUESDAY MORNING, DEC. 9, 1902, 9 TO 12 O'CLOCK.

Reception of delegates and friends by the officers and executive committee at the secretary's headquarters.



AUDITORIUM HOTEL, HEADQUARTERS INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

Registration of members, issuance of badges and credentials and tickets to the banquet, etc.

TUESDAY AFTERNOON, DEC. 9, 2 TO 5 O'CLOCK.

Address of welcome by Honorable H. S. Taylor, prosecuting attorney of Chicago.

Response by President H. C. Rainey, Fairfield, Iowa.

Report of executive committee.

Report of the secretary.

Report of the treasurer.

Selection of nominating committee by the states to report on call of the president.

WEDNESDAY MORNING, DEC. 10, 9 TO 12 O'CLOCK.

Reception of delegates and visitors by the manufacturers' supply houses and kindred manufacturing interests.

Inspection of exhibits and visiting the factories in Chicago.

WEDNESDAY AFTERNOON, DEC. 10, 2 TO 5 O'CLOCK.

Rates—Measured service, by Geo. N. Bandy, Perry, Ia.

Sliding scale rates for exchanges, by Dr. H. S. Herr, Ottumwa, Iowa.

Toll Rates, by H. H. Robinson, Cleveland, Ohio.

Discussion.

Restriction by municipal authority and authority of the law—

Ohio.....W. F. Laubach, Akron, Ohio.
Iowa.....U. S. Alderman, Nevada, Iowa.
Wisconsin.....J. C. Harper, Madison, Wis.
Minnesota.....E. E. Webster, Minneapolis, Minn.
Michigan.. .....J. B. Ware, Detroit, Mich.
Indiana.....E. W. Pickhardt, Huntingburg, Ind.
Illinois.....M. Savage, Champaign, Ill.
Missouri.....H. Linton Reeber, St. Louis, Mo.
Kentucky.....D. L. Pendleton, Winchester, Ky.

Discussion.

THURSDAY MORNING, DEC. 11, 9 TO 12 O'CLOCK.

Settlement of toll business between connecting companies, by A. L. Hutchinson, Weyauwega, Wis.

Paper—Enforcement of message time limit, by H. E. Ralston, Maitland, Mo.

Discussion.

Papers—Independent telephone securities as an investment—

(a) From a banker's standpoint, by Col. J. D. Powers, Louisville, Ky.

(b) From a small investor's standpoint, by J. H. Layne, Carthage, Mo.

Discussion.

Paper—The Berliner patent, Bell's claims of infringement and litigation now pending, by J. J. Nate, Chicago, Ill.

Paper—Suggested methods for improving long distance telephony, by Senator C. E. Hull, Salem, Ill.

THURSDAY AFTERNOON, DEC. 11, 2 TO 5 O'CLOCK.

The manufacturers will take charge of and entertain the delegates at their respective exhibit rooms and at the different factories.

THURSDAY EVENING, DEC. 11.

Banquet, tendered by the telephone manufacturers' supply houses, kindred manufacturing interests and the publishers of telephone and electrical journals.

It is earnestly requested that every one interested in Independent telephone work in the states of Illinois, Indiana, Ohio, Kentucky, Missouri, Iowa, Minnesota, Wisconsin and Michigan should attend this convention. Any corporation, copartnership or individual interested financially in or operating an Independent telephone exchange or toll line, or any corporation, firm or person engaged in manufacturing any kind of Independent telephone apparatus, or equipment, or any supply house, is entitled to membership, and should join the association, whose aims and objects are set forth by the secretary as follows:

1. Unity and harmony of action.

2. To keep in close touch with each other and with the manufacturers and supply houses.

3. The full and free discussion of all important questions involved in the Independent telephone movement.

4. The establishment of remunerative rates of rental.

5. The connecting of all local plants by long distance lines and the adoption of reasonable remunerative rates of tollage.

6. The adoption of such methods as will insure the best and most modern construction, and the use of only the best equipment and apparatus.

7. To establish a general bureau of information, not only for the benefit of those who have recently entered actively into the Independent telephone field, and those who in the future may engage and invest in the Independent telephone business, but for the education of the public generally.

8. To enhance the usefulness and efficiency and value of all Independent telephone property.

9. To increase the income or net revenue of each plant and toll line.

10. To adopt a system of auditing accounts between the various companies, or the establishment of a telephone clearing house.

11. To discourage building parallel toll lines or competing exchanges so that we may fight the common enemy (the Bell) and not each other.

12. To encourage and aid the building of toll lines and exchanges in undeveloped sections of territory embraced in the nine States composing this association.

13. To unite our energies and concentrate our efforts for the establishment of plants in, and toll line connections with the cities of Milwaukee, Cincinnati and Chicago.

14. To give every one engaged in the Independent telephone business an opportunity to actively co-operate in the good work, and thus augment and enhance his own interests.

Surely every man engaged in the Independent telephone business throughout the nine States included in this association, can heartily endorse the objects set forth, as mentioned above, by this association, and can certainly get consent of his mind to seek membership and energetically enter into the work of co-operation mapped out by the Inter-State Telephone Association. Each of the nine States contains or maintains a state organization, but a state organization is not sufficiently far-reaching in its work or connections to accomplish all that is needed in the Independent movement; but by the combined efforts of the nine States, no man can foresee or foretell what great results will surely be accomplished in the next few years. The time is not far distant when every family, no matter whether in the city, town or country, in the nine States included in this association, will be blessed, or have the opportunity to be blessed with a telephone in their home. Could anything be anticipated that would more thoroughly bless the inhabitants of these States than to make it possible that every man shall have such a convenience and necessity, luxury and comfort in his own home.

The officers of the Interstate Independent Telephone Association are:

H. C. Rainey, president, Fairfield, Iowa.
I. A. Lumpkin, vice president, Mattoon, Ill.
E. M. Coleman, secretary, Louisville, Ky.
J. C. Harper, treasurer, Madison, Wis.

The executive board is composed of the following:

H. K. Cole, Owensboro, Ky.
J. B. Ware, Detroit, Mich.
Chas. E. Hull, Salem, Ill.
Geo. N. Bandy, Perry, Iowa.
J. W. Layne, Carthage, Mo.
A. L. Hutchinson, Weyauwega, Wis.
L. A. Frazee, Connersville, Ind.

One of the features of the Interstate convention at the Auditorium Hotel will be the organization of a telephone fraternal society. The plans have been kept secret, but it is understood anyone engaged in telephone work is eligible to membership. Some of the prominent telephone men are behind the organization and it promises to be successful.

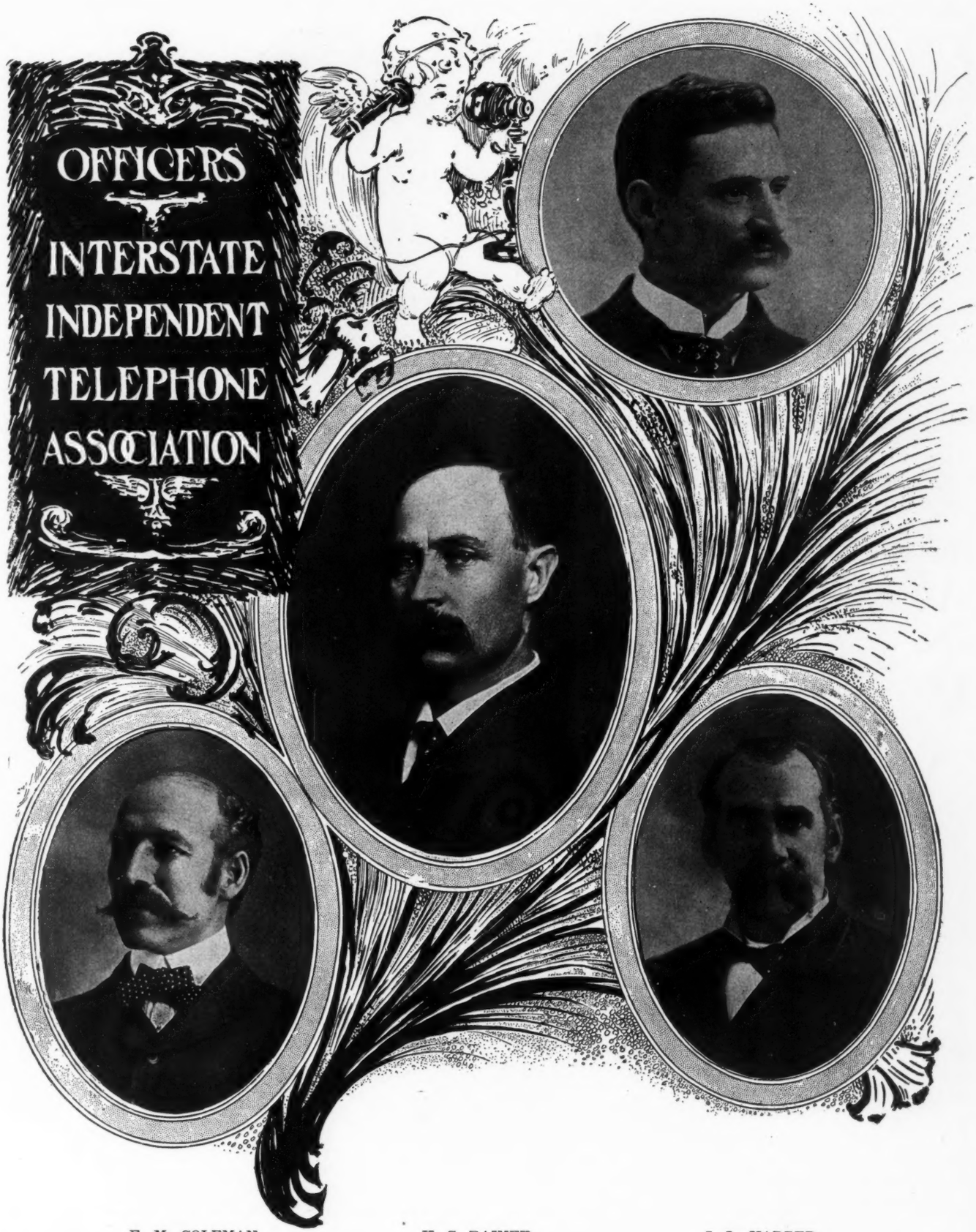
A VERY YOUNG EXCHANGE OPERATOR.

Michie Goodpaster, a bright 10-year-old girl, operates and has absolute control of the Independent telphone exchange at Edonton, Clermont county, Ohio. Her father was the operator, but, being a teacher, he was forced to give up his position at the opening of the fall term of school. Little Michie, who had often studied the work in her father's hands, pleaded successfully with the management to operate the line and she was found as efficient as any adult.

TELEPHONE TO SUPERSEDE DOGS.

The dogs of St. Bernard, so long renowned for their wonderful life-saving service, are at last to take a second place to modern invention. All the refuges on the mountainside are shortly to be connected by telephone with the principal hospital. The number of travelers, tourists, workmen seeking employment, pilgrims who cross the St. Bernard at all times of the year make this measure highly necessary.

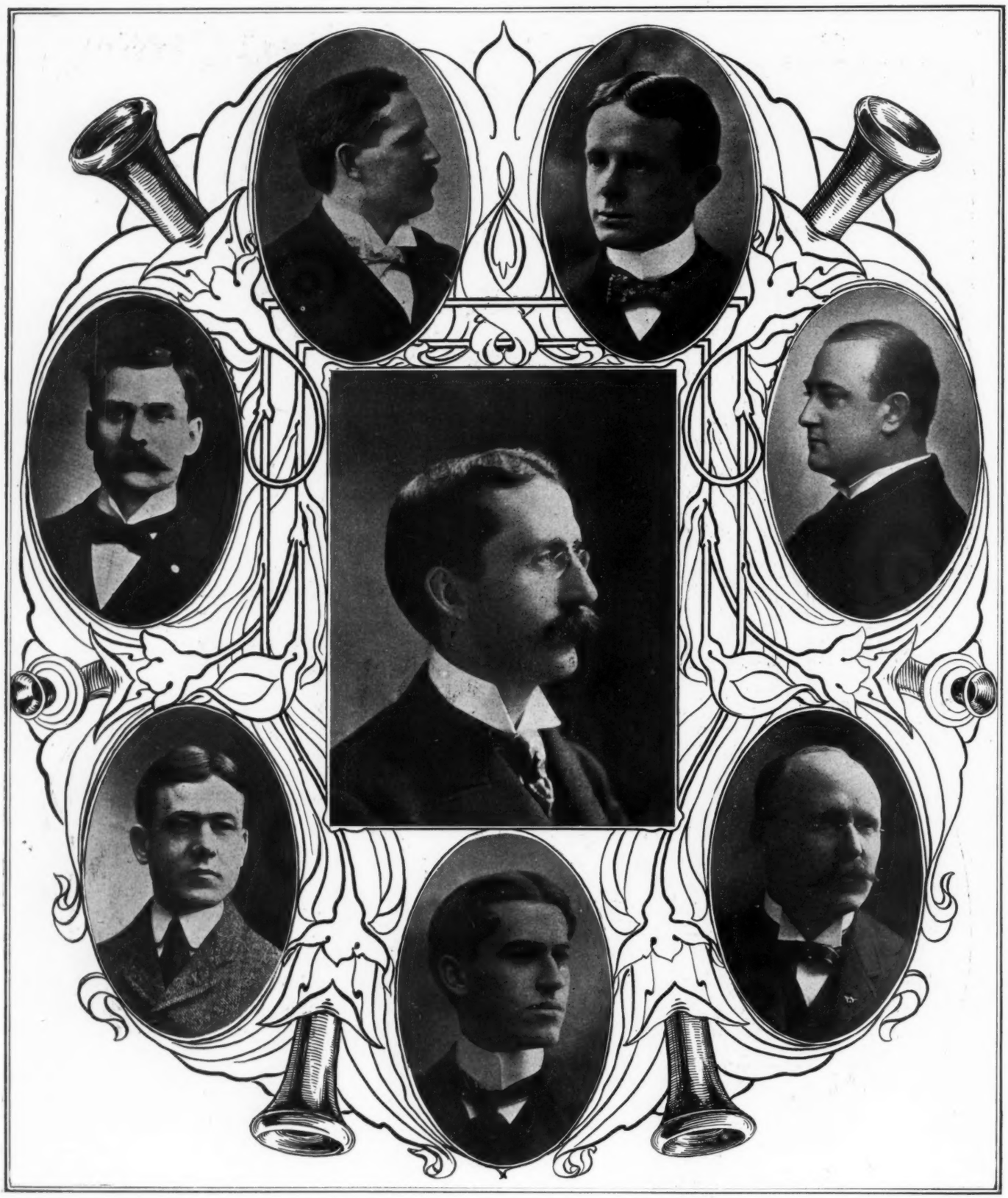
Beloit, Wis., seeks notoriety and endeavors to challenge San Francisco's claim of having the most telephones, population considered. Two companies operate 1,400 telephones in Beloit. This is one telephone to each nine persons, and is claimed to be the largest number of telephones per capita in the country. Statistics credit San Francisco with one telephone to each fourteen inhabitant.



E. M. COLEMAN,
Secretary.

H. C. RAINEY,
President.

J. L. HARPER,
Treasurer.
I. A. LUMPKIN,
Vice-President.



FINANCE COMMITTEE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION CONVENTION, DEC. 9, 10, 11, 1902.

J. E. KEELYN.

L. D. KELLOGG.

ALFRED STROMBERG.

P. C. BURNS.

E. B. OVERSHINER.

CHARLES MESSER.

W. H. SLINGLUFF.

F. M. PIERCE.

ENTERTAINMENT COMMITTEE INTERSTATE INDEPENDENT TELEPHONE ASSOCIAION CONVENTION DEC. 9-11, 1902.

WALTER E. DOOLITTLE.

F. G. JONES.

F. B. PATTEN.

JAMES WOLFF.

J. J. NATE.

C. W. FARR.

H. B. M'MEAL.

S. A. DINSMORE.

DIGEST OF TELEPHONES AND KINDRED PATENTS

Conducted by EDWARD E. CLEMENT.

OCTOBER 21.

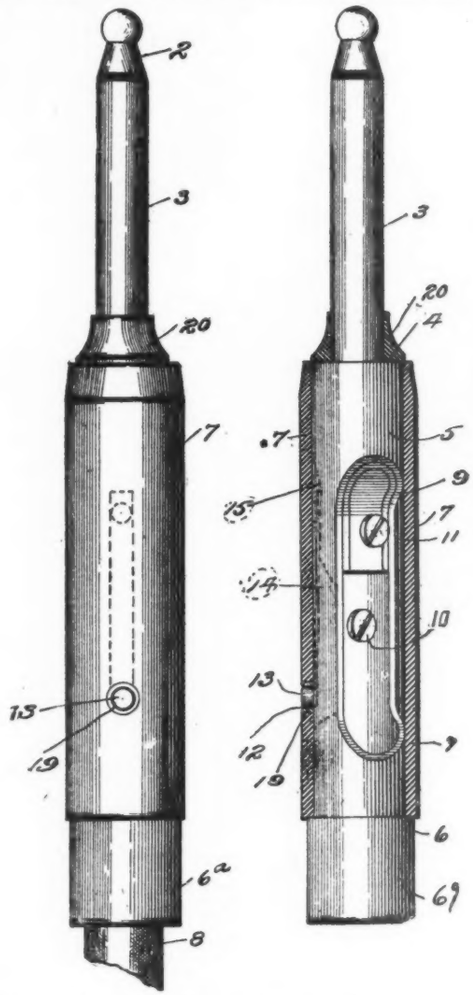
711,556—H. B. Clausen, Telephone Switchboard Plug.

The invention in this case will be remembered by many telephone men to whom Mr. Clausen has shown it, as a very ingenious arrangement of a spring catch to hold the sleeve of a plug in position, instead of the delicate and expensive screws heretofore used. The device will be best appreciated by the shopman who has been forced to have special taps and dies made in order to get the fine threads required, and by the switchboard men who have had to hunt for trouble caused by the loss of these same small screws around the operator's key shelf, and who have many a time resorted to pocket knives when no screwdriver was available small enough to enter the tiny slot.

The invention consists essentially of a leaf spring 12 secured in a milled slot in the side of the plug body, and sprung with an outward tendency. This spring carries a head 13, and the fibre sleeve 7 has a corresponding hole 19, properly bushed to prevent wear. When putting the sleeve on, it is pushed along and turned until the hole comes over the spring head 13, when the spring forces the latter into the hole, thus constituting a latch, preventing the displacement of the sleeve. In order to remove the sleeve, it is only necessary to push in the button 13.

In the figures herewith, that on the left is a side view of the plug showing the sleeve in position, and the spring in dotted lines, underlying the same. The figure on the right is a side view of the plug at right angles to the former, with the sleeve in section, and shows in dotted lines the milled slot 15, the spring 14, the button 13, and the latch hole 19. The cord connections are made as usual through the ordinary milled out opening 9 in the body of the plug.

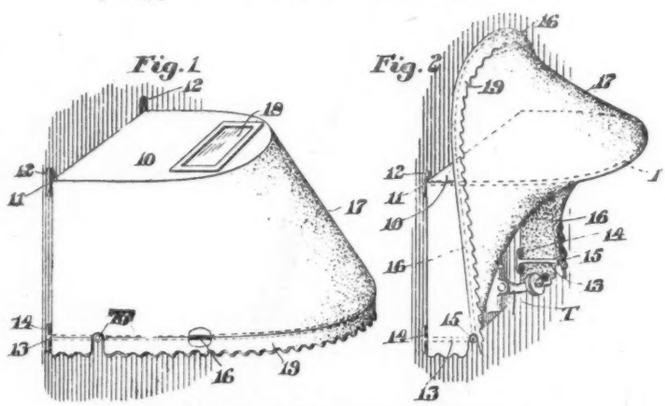
A secondary feature of the invention is the provision of an insulating ferule 20 to prevent the sleeve contact from touching the test ring of the jack.



711,556—TELEPHONE SWITCHBOARD PLUG.

711,588—A. J. Parke, Inclosure for Telephones.

This is an enclosure in the nature of an awning, intended to assist in preventing outside noises from disturbing the user of a telephone. It consists essentially of a rear frame or support 10, 11, 12, 13, secured to the wall above and around the telephone T, and a bowed frame 16 pivoted at 15. The upper part 10 of the fixed frame extends out to form a roof and is provided with a glazed window 18 to admit light. A flexible material is secured around the bowed frame like an awning cover, so that the latter can either be let down as shown in Fig. 1 or turned up as shown in Fig. 2. When in use the "man behind the 'phone" has his head and shoulders shielded.



711,588—INCLOSURE FOR TELEPHONES.

711,589—A. J. Parke, Inclosure for Telephones.

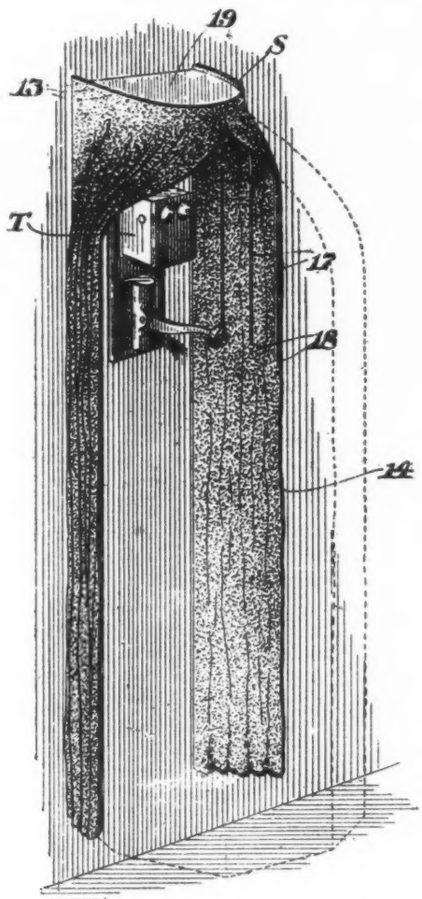
We have all heard of a copious flow of language, and we presume the telephone girl does not always need to be informed whether it is the hot or the cold spigot that is turned on. We have also heard of the man who gets mad with the fellow at the other end and smashes his telephone in his rage, and we have thought how much better it would be to spout a deluge of good icy sarcasm, with perhaps a spurt or two of hot condemnation at the finish. But it has

remained for genius to perceive the possibilities of all this and develop the telephonic shower bath.

This invention consists of a glass roof 19 over a telephone and side curtains supported on pivoted frames 17 so that they may be closed about the person of the user of the telephone. The object is to shut out extraneous sounds.

711,615—J. W. Brown, Mouthpiece for Telephonic Transmitters, etc.

This is an antiseptic mouthpiece, according to the title, but more accurately speaking it is a holder for solid or liquid germicides, adapted to be secured to the transmitter, and itself carry the mouthpiece. It consists of the hollow cylinder D, having central perforations to admit the hollow core d3, which is perforated at d7, and has an integral flange d4, and a removable flange d5, this core being surrounded by



711,589—INCLOSURE FOR TELEPHONES.

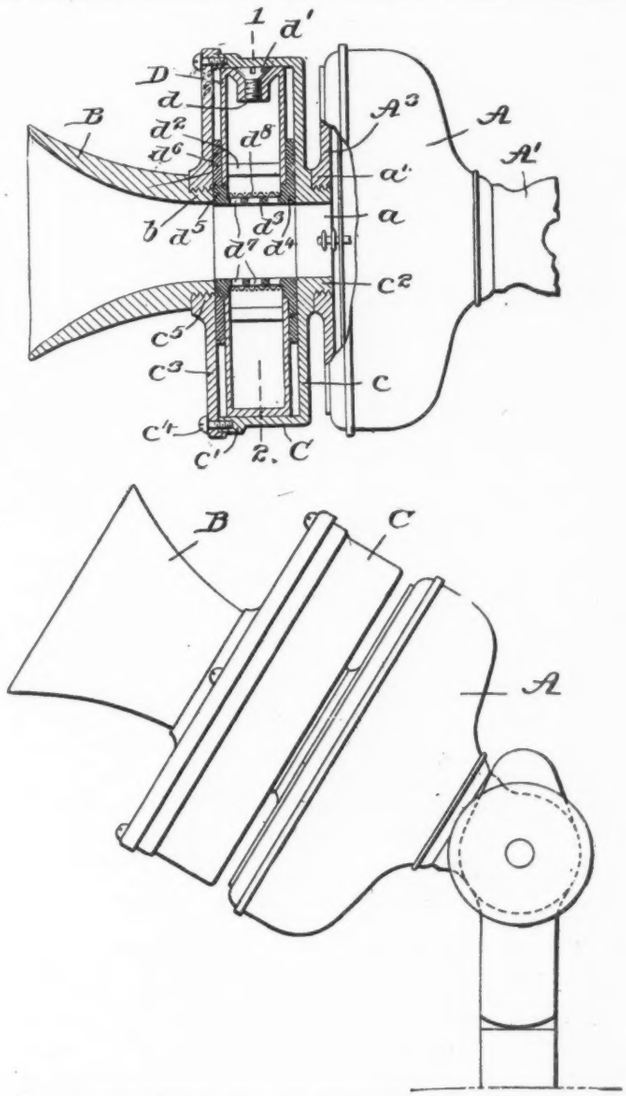
a covering of fabric d8, whose function is to confine the antiseptic solution or substance to the cylindrical chamber. The holder is inclosed in a casing C, having a rear shell portion c, a flange c' and a cover plate c3, all corresponding to the parts of an ordinary transmitter shell. The mouthpiece proper screws into the cover plate c3 at c5, as usual in the transmitter. The casing C is screwed into the transmitter front plate at a', in place of the ordinary mouthpiece, and voice waves are propagated through the central channel or opening d3 from the mouthpiece B into the transmitter to the diaphragm a.

The inner shell or cylinder D is provided with an opening d for inserting the germicide, but it seems that the whole thing has to be taken apart before this cylinder can be reached.

In operation the fumes of the germicide are supposed to emerge through the holes d7 in the core d3 and permeate the interior of the mouthpiece B, the tubular passage and the transmitter.

711,640—W. M. Miner, Telephone Receiver.

The invention in this case resides in the perforation of the cap of the receiver shell with a multiplicity of small holes instead of one large hole. The idea is ingenious and has been widely copied. It prevents injury to the diaphragm, as the prongs of the telephone hook cannot pass the small holes, and it prevents the tampering with lead pencils and other instruments to which instruments are often subjected in idle moments. It is also claimed that the



711,615—MOUTHPIECE FOR TELEPHONE TRANSMITTER, ETC.

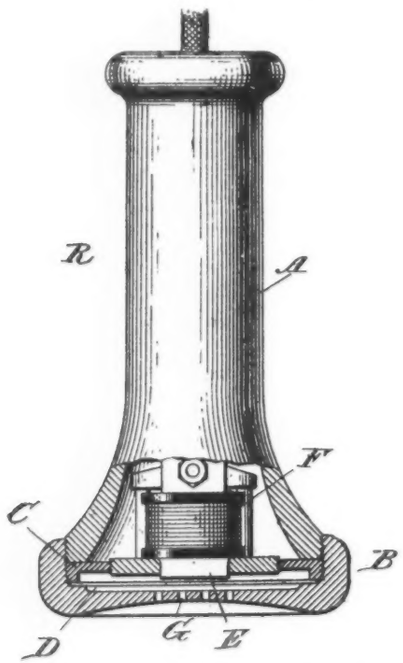
sound is broken up more completely and loses the explosive force that so often characterizes strong receivers, becoming more natural without losing its loudness.

711,941—A. C. Crehore and G. O. Squier, Submarine Cable Telegraph.

This application was filed Nov. 3, 1898, and is one of the famous series embodying alternating current methods in telegraph transmission. A prior application, filed Oct. 25, 1898, contained claims broadly for the improvement in submarine which consists in impressing upon the cable, for transmitting signaling waves, electromotive forces changing gradually and continuously from zero through a maximum to zero. The present invention is mainly designed for use with submarine cables, but is not limited thereto.

The object of the invention is to increase the working capacity of submarine cables by diminishing the number of pulses which it is necessary to employ in transmitting a message. It is directed mainly to the manner of distinguishing the various characters of any code from one another by a combination of the elements of time, polarity and electromotive force applied to the circuit.

In cable telegraphy, as is well known, the practice has been to impress upon the cable suitable pulses by an electromotive force sometimes positive and sometimes negative, and at the desired times or intervals, according to the code employed, positive pulses of one polarity being ordinarily used for the dashes of the alphabet or code and opposite pulses for the dots of the alphabet, the messages being read at the receiving end by the deflection or to and fro movement of an arm, stylus or other device, either directly by observed movements thereof or else by causing said device to make a sinuous mark upon a strip or sheet. In that system the times or intervals at which the deflections occur and the directions or movements of the instrument enable



711,640—TELEPHONE RECEIVER.

the characters of the code to be distinguished. The minimum number of pulses which it is necessary to employ in sending a message is then practically determined by the fact that the two elements only of time and polarity are employed. No attempt is made to employ a difference in the magnitude of movement of the receiving instrument.

The present invention aims to superimpose upon or compound with the other elements this difference in magnitude which may coexist with those of direction and interval of time, and thereby to diminish the total number of pulses necessary to employ in order to send all the characters of any code. This is accomplished by varying electromotive forces impressed on the cable coincidently with the transmission of the pulses.

In the figures herewith Fig. 1 shows graphically the arrangement and polarity of pulses of electromotive force impressed in sending a message by the international code. Fig. 2 shows the effect of combining the differences in e. m. f. with time and polarity. Fig. 3 shows another set of combinations.

It is assumed that an instrument like the siphon recorder is used as a receiver, inasmuch as that instrument furnishes a superior means of interpreting or receiving the current transmitted over the line. The siphon recorder approximates an accurate curve tracer, indicating the changes of current with the time and giving all the information which it is conceivable the current contains. In land telegraphy the receivers (relays or sounders) ordinarily indicate whether the current is absent or present, and sometimes whether it is positive or negative (polar relays). The element of time alone is used in the Morse system, where the sounder indicates the presence or absence of current. The elements of time and polarity alone are used in the chemical receiver, which gives a record in one place for a positive and in another for a negative current. This addition of polarity alone

Fig. 1.

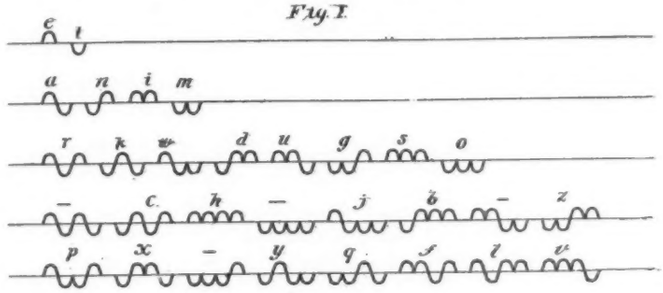


Fig. 2.

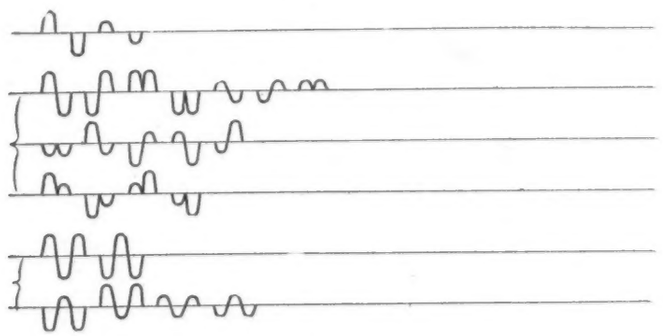
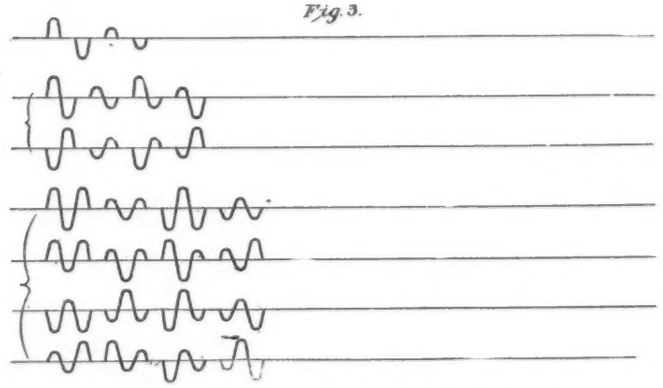


Fig. 3.



711,941—SUBMARINE CABLE TELEGRAPH.

to the time element gives so much greater facility in interpretation that for the same number of waves or impulses about three times as many words per minute may be received and transmitted. At present the siphon recorder is used in cable telegraphy making use of time and polarity only. By the addition of changes in e. m. f. or "current strength," therefore, which gives curves of varying amplitude of height, it may be seen there is another substantial gain.

Fig. 1 shows how the impulses of opposite polarity are combined to produce the international code characters. It will be observed that combinations of pulses up to four at a time are required, and the greater number have two or more pulses of the same polarity succeeding each other. In Figs. 2 and 3, on the other hand, are shown characters

indicated by changes in the e. m. f. on the line as well as by the polarity and time.

Comparison shows that whereas in the old manner, as shown in Fig. 1, using four as the maximum number of pulses for any character, there are thirty combinations possible, four of which are not needed, twelve having four pulses, eight three pulses, four having two pulses and two having one pulse each; according to the improved arrangement, employing changes in strength, using the three elements of time (closure) polarity, and e. m. f. difference, eighty-four characters are possible, but as only twenty-six are needed an alphabet can be constructed having four characters with one pulse each, sixteen with two pulses and six with three pulses.

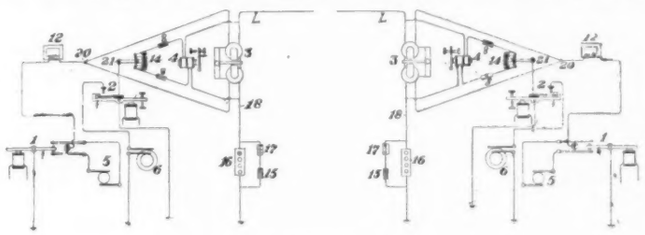
In selecting the particular combinations to be used attention is given to a condition that is well known to engineers who have studied the subject—i. e., the piling-up effect due to recurrence of pulses of the same polarity. When two successive waves of the same polarity are sent into a cable the current does not return to zero value, and as a consequence the piling-up effect tends to displace the siphon off toward the edge of the paper and make it harder to read because there is little distinction on the record between successive pulses, the tendency being for them to merge into one large one. If a continuous stream of impulses of the same polarity is sent into the cable the record shows a wavy line starting from the middle of the tape and oscillating about a median line displaced at a sharp angle to one side, but gradually coming back to the middle, owing to the condensers in the line. After this return its appearance cannot be distinguished from that of a simple sine-wave alternating current. In fact, the same record could be made in either of two ways—first, as above, and second, by using an alternating current of double the frequency. This being so, and the first characters to become illegible being those having two or more waves of the same polarity in succession, their use is detrimental to speed. Consequently, as shown in Fig. 3, the patentees have shown the preferred arrangement of characters, selecting those out of the eighty-four possible, wherein no two successive characters are of the same polarity. Higher speed is thus attained.

The apparatus for this system is not essentially different from that previously described in systems of these patentees. It consists essentially of a perforated transmitting tape having four rows of perforations for the brushes and a middle row for the feed wheel. One pair of brushes send current of opposite polarities to line of the same strength, the other pair of opposite polarities and less strength. The circuit is made and broken at the "zero potential" found by the absence of sparking.

711,942, A. C. Crehore, Telegraphy.

In quadruplex telegraphy it is the practice to transmit in the same direction by changes of current tension and changes of polarity of a continuous current. Difficulty is experienced in maintaining the adjustment of instruments on all "four sides" of the system, and the fourth side is generally weak and uncertain in operation. Moreover, special provision has to be made for preventing "kicks" in the instrument, which responds to changes in tension whenever a reversal of the current takes place on what is called the "No. 1" side of the circuit. The object of the present invention is to render the receiving instruments at each station insensible or irresponsive to outgoing signals and yet do away with the difficulties named. Transmissions from one station are effected over one side of the system by the use of a continuous current, and the transmission for the other side is effected by pulsatory currents superposed upon the continuous currents, the pulsatory current apparatus being, however, connected to line and having its receiving apparatus balanced or rendered neutral to outgoing signals in such manner that any disturbance of the exact balance of the main and artificial lines shall not produce any disturbance on the continuous current side from the working of the pulsatory-current side. In other words, double transmission from each end of a quadruplex line is effected by "superposed currents," one message being sent by currents from a generator adapted to generate momentary currents of short duration and sharply defined or having a high rate of change of e. m. f.—that is, pulsatory currents—and the other message is sent by currents of long duration or "continuous currents." On the continuous current side either changes of tension or "double-current" transmission—i. e., change of polarity—can be used, and on the other side a succession of pulsations is used preferably—for instance, two impulses with an interval of zero potential. By working the continuous current side also with changes of polarity as well as tention a "sextuplex" can be attained, but with the disadvantages inhering in any quad.

The main feature of the invention consists in using for the two sides of the system balancing branches derived from independent apexes or points of division, to which are joined, respectively, the branch or ground connections containing the transmitting apparatus for the two sides of the system. The invention also includes, with the continuous current transmitting apparatus joined to the apex from which diverge the balancing branches for the receiver, inde-



711,942—TELEGRAPHY.

pendent balancing branches for the receiver of the pulsatory side, and an inductance in the ground connection containing the continuous current apparatus.

In the figure the continuous current transmission is shown as effected by the generator 5, by "double currents," through the pole changing transmitter 1, operated by a magnet as usual; 3 is the receiver for the continuous current side, with differential windings, one in the branch from point 20 to the line L, the other in the artificial line from same point, with usual condenser and adjustable rheostat.

The transmitting apparatus, comprising 5 and 1, is connected from point 20 to earth. On one side is the impedance coil 12, to choke out the pulsatory currents.

The transmitting apparatus for the pulsatory side of the system comprises instrument 2 and generator 6, in a branch from an independent point or division 21, to earth, other branches going to line L and to artificial line 18 through condensers. The receiving instrument for the pulsatory side is rendered neutral to outgoing signals by the balancing effects of the two branches leading from 21 to the lines L and 18 in any desired way, as by differentials, but in each branch there is a condenser to permit pulsatory currents to flow, while continuous currents are held out.

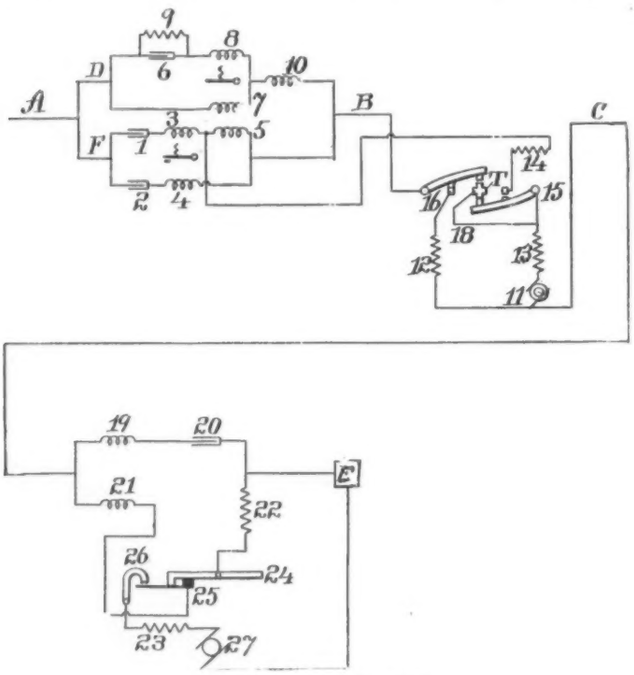
711,943—A. C. Crehore, Telegraphy.

This invention also relates to superposed current transmission, sending one class or set of messages over a wire by the use of currents of short duration and sharply defined or having a high rate of change of e. m. f., while another set is sent by currents of longer duration or having a lower rate of change. Reference is made to certain other applications covering systems in which the methods herein set forth are particularly useful, Nos. 79,383, 79,384, 79,385, 79,386 and 79,387, all filed Oct. 21, 1901.

With the frequencies of alternating current and strengths of current employed in the prior systems

disturbances are likely to arise from the inductive effect of such currents upon neighboring telephone lines. If the attempt be made to remedy this difficulty by using lower frequencies and less currents there is a liability to interference between the two sides of the system itself, and the present invention is particularly concerned with overcoming such difficulties. Another object is to permit two separate parties, each on a single Morse wire, to communicate independently with distant stations over a single main line wire operated as a superposed telegraph circuit by the use of repeating apparatus.

The system shown in the figure is devised for working at comparatively low frequency of alternating current (fifty or sixty cycles per second), and also for comparatively small values of transmitting e. m. f., in order that it may be suitable for operation in proximity with telephone circuits or in conjunction with telephone circuits, either on the same wire or on separate wires on the same pole line. It has been found that the frequency of one hundred and fifty cycles per second, which was found advantageous for the duplex-diplex system described in the applications referred to above, is not permissible on wires in close proximity to



711,943—TELEGRAPHY.

telephone circuits, because of the extreme sensitiveness of telephones to small alternating currents of this periodicity. The difficulty of working a duplex-duplex system at a low frequency is much greater than at a high frequency. This is partially due to the fact that a very large condenser is not permitted to be employed around an ordinary Morse key. It has been found in practice that a Morse operator can detect the presence of a condenser of anything over three micro-farads. The impedance of so small a condenser as this at the low frequency is very greatly increased, and it is not easy to construct an inductance coil that will balance the condenser without introducing considerable apparent resistance, the total impedance added to the line for the low frequencies being much greater than with high frequencies. Moreover, with the low frequency it is much more difficult to differentiate between the Morse currents and the alternating currents received, which is natural when it is considered that if the frequency is decreased to a very low value the current is approximating the Morse current itself in character. The kicks produced on the alternating receiver by the operation of the Morse key are caused by currents of a variable character, which produce effects more nearly like those of an alternating current at fifty or sixty cycles than at one hundred and fifty, and for a successful system the designer must differentiate between these sudden effects produced by the Morse key and the alternating current received. The apparatus is supposed to differentiate in this manner very successfully. It consists of the receiving apparatus D-F, the alternating current transmitter T, and the continuous current transmitter 25. The line wire comes at A and passes to points D and F, where it is connected, at the former point to the direct current or Morse receiver 7-8, and at the latter point, F, to the alternating current receiver 3-4. Reuniting at B, the circuit is continued to the transmitter T, consisting of a continuity preserving key, whereby the alternating generator 11 can be cut in and out without breaking the through path for currents of both kinds, and from thence by wire C to the transmitter 23, having also a continuity preserving key 24, whereby the direct current generator 27 can be cut in and out.

The receiver 3-4 is a differential polar relay having coils 3 and 4, and having in circuit the condensers 1 and 2 to keep out the direct currents. In circuit with one of the windings, 3, is an inductance coil 5, which unbalances the relay for incoming currents. It remains balanced for outgoing currents from the alternating current generator, however, as the transmitting key closes a shunt 14 around the coil 5 when the generator is connected. It is stated that more current is actually realized in the circuit 1-2-4-5-3 during receipt of signals than comes in over line A, due to the tuning of the said short circuit, which resonates, and this resonant effect is in the proper path to produce maximum effect on the relay 3-4, for as the coils are differential to currents in parallel from F to B, they augment each other in series. Thus the received alternating currents have much greater effect than any kicks due to the Morse key.

The direct current receiver consists of a differential relay, which may or may not be polar, and has coils 7 and 8. An inductance coil 10 is provided, which keeps out most of the alternating current and what passes is neutralized in the differential windings. In order to unbalance the relay for direct currents a high resistance non-inductive coil 9 is employed, which is in series with coil 8, but is shunted by a condenser 6 to allow the alternating currents free passage to both coils.

Currents coming in over the line find a path to earth from A to B, to 16, normally to 12, C, 21, 25, 24, 22 and E. When transmitter T is in operation they pass from 16 to T, 18, 13, generator 11 C and so on. When transmitter 25 is in operation they pass by 21, 25, 26 generator to E. For the alternating currents, and to avoid the inductance of the generator windings, a condenser 20, with a coil 19, is provided, and a retardation coil 21 prevents their passing the other way.

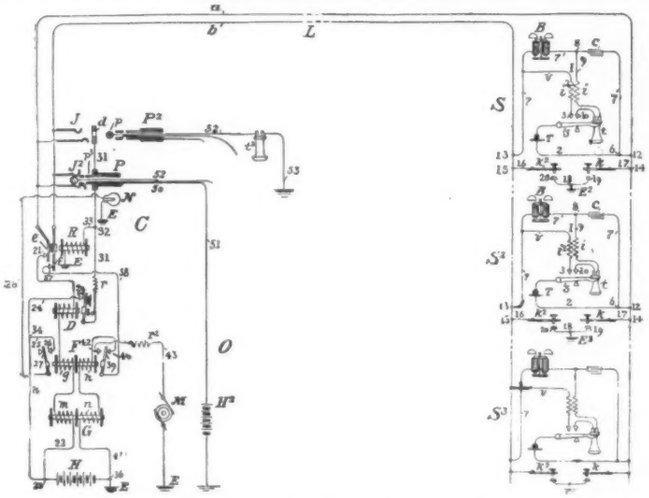
711,973—D. S. Hulfish, Signaling and Switchboard Apparatus for Telephone Exchange Circuits.

This is a calling scheme for common battery party lines whereby a subscriber may easily call other subscribers on the same line without the interposition of the central office operator, and may also call central in the usual way; also whereby the line will test busy when so put into use, even though no plug is inserted in any jack at the central office. In magneto systems these same ends are attained by the use of a code, and the operator pays no attention to the signals intended for other subscribers called by one of them on the line. In common battery systems, however, it has usually been necessary to call central and have the wanted subscriber called up in the regular way, whether on the same or another line.

The system is the well-understood "relay system" of the

Bell Company, wherein the line wires a and b of the metallic circuit come into the central office and pass the jacks J to the contacts of the cut-off relay R, one of them then connecting through the line relay to the battery H and ground, and the other through a balancing resistance. In the present case, however, while the balancing resistance or impedance G is used, having coils m and n in the two sides of line, there are two relays, D and F, instead of the one line signal relay. The relay D controls circuit E, 36, H, 23, 24, r, 31, to test rings d, while the relay F, which is differentially wound, with its two windings in the two sides of the line, controls the circuit E, 36, H, 23, 34, 26, 27, 28, to line lamp N and ground E. The relay F has a second armature, 39, which, when attracted connects the calling generator M to line wire b, by the circuit E, M, 43, r2, 39, 38, 37, b.

S, S′ and S2 are three subscribers' stations on the line a-b. At each station the ringer B is bridged with a condenser c, as usual, and the switchhook puts the telephone set across the line when it goes up. In addition to the ordinary arrangements, however, each subscriber has two grounding keys, k and k2, one for each side of line. The key k is used for calling other subscribers, while the key k2 is used for calling central. In the former case the subscriber takes down his receiver and listens to ascertain if



711,973—SIGNALING AND SWITCHBOARD APPARATUS.

the line is in use, and if not replaces his receiver and presses key k. Current flows from main battery H over line wire a to the subscriber's station and to ground through the key. This current, passing through only one winding of relay F, causes the attraction of its armatures and puts the generator M to line, by wire b. The key is then worked in accordance with the code, to call the particular subscriber wanted, and the current passes out to all the stations by the wire b, through all their ringers, and to ground by the one key on the other side. All bells are thus rung, and at the same time the armatures of relay F, being intermittently attracted, the line signal lamp is only flashed and operator, knowing that calling is meant for that line only, pays no attention. After calling, the subscribers take down their receivers and converse, hanging up when they have finished. As soon as the armature of relay D is attracted, at the beginning of the call, the circuit to the test rings is closed and the line thereafter tests busy until the subscribers have finished.

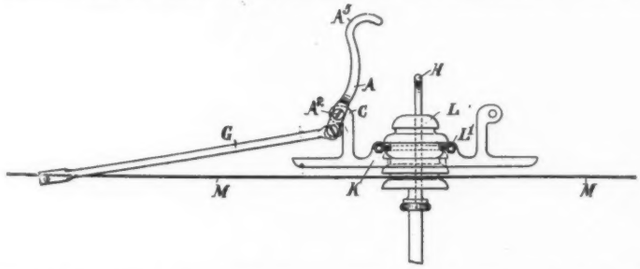
In calling central the subscriber takes down his receiver and listens to see if the line is in use, and if not he leaves the receiver off the hook and presses key k2. Current flows from battery H through line wire a as before, out to the subscriber's station, and across through his talking set to the line b, and so to ground by the key. Relays F and D again attract their armatures, the line lamp is lighted and the generator M is put to line, but the latter does not call any one, as it is practically short-circuited through the key, and the line lamp remaining steadily lighted informs the operator that her attention is desired. When the plug P2 is inserted the cut-off relay is operated as usual by current in circuit H2, 51, 50, d, 33, R and ground, and all the other relays, etc., are removed from the line. The further operation is then in accordance with the established practice.

Suitable resistances r2 and r are used to regulate the currents employed. Thus the generator current through r2 never exceeds a certain safe flow, even when the short circuit through the key k2 is closed to earth; and the current through r to the test rings is insufficient to operate the cut-off relay.

712,060—R. Hacking, Overhead Telephone, Telegraph or Like Wire.

This is a safety support for wires, so arranged in the case of telephone and telegraph wires that if they break and fall upon other wires carrying dangerously heavy potentials the telephone or telegraph wire will be grounded, in order to divert the high potential current. The device is really intended for trolley wires, and this application is rather an afterthought, but still it may have some practical use.

In the drawing L shows an insulator carrying the wire M, and also carrying a bracket K, upon which two arms A (only one of which is shown) are pivoted at A2. Normally these arms are held up by stiff links, G, attached to the line



712,060—OVERHEAD ELECTRIC CONDUCTOR, OVERHEAD TELEPHONE, TELEGRAPH OR LIKE WIRE.

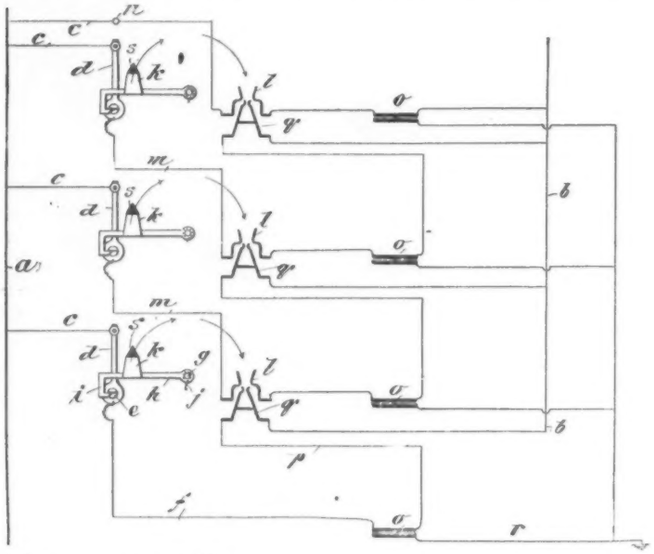
wire at some distance outside the insulator. In case the line wire breaks, the weight pulls out the short arm of the lever and the longer arm, A5, comes down on a ground post H, carried above the insulator. In the trolley form this ground post is connected to the return or rail circuit, so as to blow the fuse or work the circuit-breaker at central.

712,204—E. W. Pelton, Automatic Switch for Fuse Wires in Electric Circuits.

This is really a magazine fuse arrangement, whereby upon the rupturing of a protected line by the blowing of the fuse a new fuse is brought into circuit. In the arrangement chosen for illustration carbon arresters are also included in the circuit beyond the fuses, and when a new fuse is cut in a new and unused carbon arrester is also cut in. Here *a* is the line wire entering the station; c-c-c-c are fuses, the circuit normally being through the lowermost fuse c to the pivoted arm d, which has a detent on its shaft formed by milling off one-half the end of the shaft at *e*. Under one edge of this detent is normally held the hooked end of the pivoted arm h, which, by reason of the impelling force of a coiled spring j on its spindle g, tends to turn over to the right when released. This arm carries a wedge k of conducting material, tipped with insulating material s, so located that when the arm turns over the wedge will pass between and electrically connect the fixed springs l; while the insulating tip will force apart and disconnect the springs q.

If the lowermost or normal fuse, c, is burnt out by a

heavy current, arm d is released and flies to the right, releasing arm h, which turns over to the right, the wedge k, with tip s, then joining springs l and separating springs q, thus closing the path from line *a* through the second fuse wire c, arm d, wire m, springs l, arrester plate o, next upper springs q and so to wire b and to the instrument. This is particularly intended for use in protected circuits in outlying buildings where the blowing of a fuse would result in long interruption of the service until a repair man could get out to the station. It will be noted that if the second fuse blows a third set of protective devices is brought into cir-



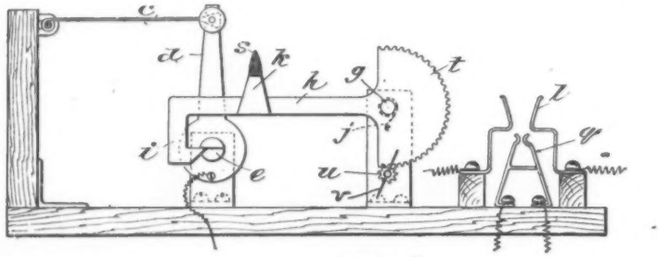
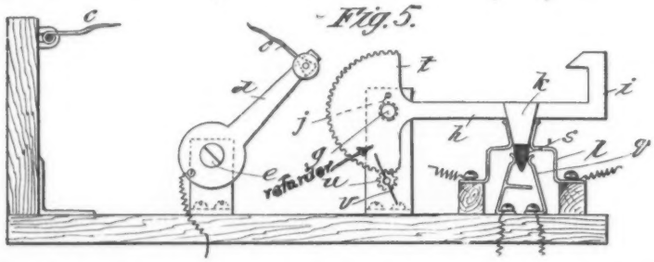


Fig. 5.



712,204—AUTOMATIC SWITCH FOR FUSE WIRES IN ELECTRIC CIRCUITS.

cuit and so on, a new carbon arrester coming in each time with the new fuse.

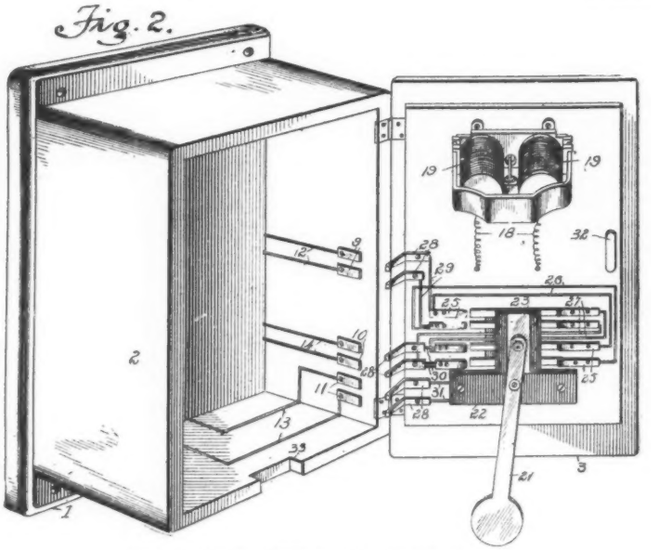
712,402—G. T. Newman, Telephone Attachment.

This is a switching attachment contained in a separate box, with a magneto ringer and adapted to be secured near a complete telephone with private and party line connections. When the handle of the switch is moved one way the telephone is connected to the party line and the auxiliary ringer to the private line; while when the switch is thrown the other way the telephone is connected to the private line and the auxiliary ringer to the party line. Thus a call over either line can be received and privacy always attained by two or more parties who have a private connection.

Fig. 1 shows the arrangement of circuits and Fig. 2 the switch. This consists of a sliding insulator, 23, carrying springs to bridge the necessary circuit terminals 25 and 27,

Fig. 1.

Fig. 2.



712,402—TELEPHONE ATTACHMENT.

30 and 31, as it is moved one way or the other; and a lever, 21, for moving it.

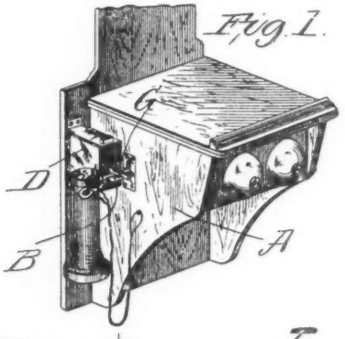


Fig. 1.

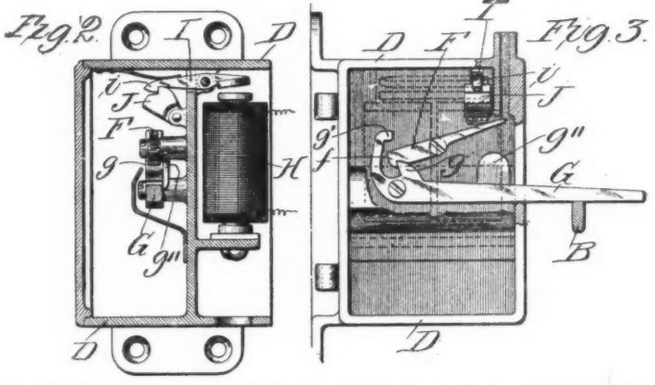


Fig. 2.

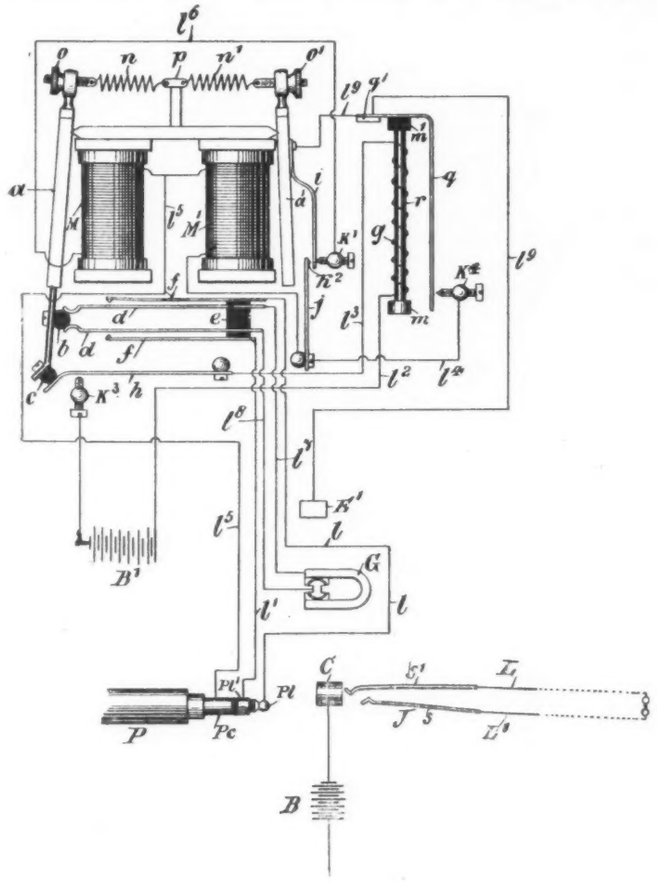
Fig. 3.

712,559—COIN CONTROLLED APPARATUS FOR TELEPHONES.

712,559—E. G. Lewis, Coin Controlled Apparatus for Telephones.

This is a controlled lock for the telephone switchhook,

so arranged that the hook cannot rise until toll has been paid for an outgoing call. For incoming calls a magnet controls the mechanism, releasing it the same as if a coin were deposited. In the drawings G is a lever extending out of a cast metal box D and overlying the ordinary telephone switchhook B. As shown in Fig. 3, this lever G is pivoted within the box and has a tooth g, and an overhang finger g1. A second pivoted lever, F, has one arm lying beneath a coin chute, and the other provided with a hook, f, that



712,619—ELECTRICAL RELAY.

normally engages the tooth g and locks lever G. When a coin is dropped in the chute it tilts lever F, lifts hook f from tooth g, hook f stopping under overhang finger g′ until the receiver is removed from the hook. The latter rises, pushes up lever G, which pushes up lever F, which tilts to the right and drops the coin, and then as the upward movement of lever G continues is again tilted to the left and brings its hook f into position to engage with tooth g, when the telephone is hung up.

For incoming calls, there being no toll required, a magnet H is provided in the ringer circuit, and controlling a detent lever i, which normally supports a pivoted weight J over lever F. When a call comes in the magnet releases the weight, which tilts the lever the same as a coin;; and when the lever G rises a projection g″ restores the weight.

712,619—A. T. M. Thomson, Electrical Relay.

This is a relay and connections for use in automatically ringing subscribers. It consists generally of switches and a timing device. Ordinarily such automatic devices have either not operated long enough to alarm a subscriber properly or have been a positive nuisance, as in St. Louis, by continuing to ring until he actually answers.

Electromagnets are here connected in such a way with a battery or its equivalent that the making of a contact by the operator at the exchange energizes one of them. This electromagnet when thus energized attracts its armature and thereby makes certain electric contacts. One of these contacts connects the exchange-generator to the line, causing the subscribers' bells to be rung. The second of these contacts connects a timing device to a local galvanic battery or other source of electrical power. A current from this local battery then flows through the timing device. The form of timing device employed consists of a movable and preferably vertical rod or wire of metal, ebonite or other material expansible by heat, fixed at one end, a coil of thin high-resistance wire insulated from the vertical rod or wire by means of asbestos paper, paint or other suitable equivalent being coiled around the said rod. The vertical brass rod or wire is capable of expansion vertically. When the current from the local battery flows through the thin high-resistance wire, which it does when the second of the above-mentioned electric contacts is closed by the movement of the first of the electromagnets, as above described, the flow of current through the high-resistance wire heats it, and the heat being communicated from it to the vertical rod or wire causes the latter to expand. The upper end of the rod or wire by this expansion is adapted to move a lever, which may be bent or hinged, or a flexible piece of metal or the like equivalent device capable of carrying a third electrical contact, which is made by the movement produced by the expansion of the vertical rod. The heating of this coil of wire and the consequent expansion of the metal rod require time. This period of time may be arranged to suit the requirements of each individual case. When this third contact is made by the action of the heating appliance, it throws a second electromagnet into parallel with the first. This second electromagnet is not energized until the metal rod of the above described thermostatic timing device by expanding makes a contact and attracts its own movable armature, which, on being attracted, breaks a contact in series with the first of the electromagnets already mentioned, through which the current which energized it has up to that instant been flowing, and thereby disconnects the said first electromagnet from the circuit, while at the same time it makes a fifth electric contact, which has the effect of permitting the current to continue flowing through the coils of the second electromagnet and to continue energizing it as long as the line is in use. When the first of the electromagnets is thus thrown out of circuit by the operation of the second, it of course releases its armature. This interrupts the connection between the generator and the subscriber's bell (which thereupon stops ringing) and also disconnects the battery from the timing device. The effect therefore is, when the connection is made at the exchange, to cause the subscriber's bell to start and continue ringing until the timing device has heated up and made the contact which the movable portion of it carries. The generator is then cut out and the bell stops ringing.

The description is quite elaborate and ornate as the invention. Mr. Thomson is an Englishman.

There are three hundred and twenty-eight postoffice telephone trunk wire centers in London. The trunk circuits in use number 1,165 and contain about 98,000 miles of wire. It is estimated that 10,080,716 trunk wire messages were communicated during the past year.

At Waterloo, Iowa, it is reported that the Cedar Valley Telephone Company proposes to open an information bureau with a young lady in charge whose sole duty it will be to answer questions and gather news from all points covered by the system. It is believed the press in the immediate vicinity will subscribe for the service and that it will ultimately become self-sustaining.

Raw Material Used in Telephone Apparatus.

A Series of Articles by H. M. Deavitt.

INSULATING MATERIAL—WAXES.

It is the tendency at the present time to experiment and find out as much as possible regarding the character of material used in manufacture, always trying to find something that does the work better or maintains the same standard at less expense, and it is only from a careful study of its properties that it is possible to intelligently perform such work. In the telephone business especially, where the cost of the raw material is small compared with the expense of labor necessary to turn out the finished product, it is paramount that the telephone does not lose a large degree of its efficiency, simply because one part was not properly selected or did not receive the right kind of treatment in its manufacture.

It is interesting, as well as instructive, regarding mineral substances to note their historical side, tracing out from their discovery, when found associated with other products, their more valuable and from a beginning when they were thrown away as useless to the later periods when their worth has increased as new uses have been found for them. Furthermore, information that can be obtained of the crude material and its process of purification, the better understanding can be had of its action and the more intelligently it can be adapted to the right purposes.

Paraffine in a fossil state, under the name of earth wax or ozokerite, has been known in Europe for centuries, but it was not until 1830 that it was discovered to be a product of distillation of several organic bodies under high temperatures. This compound derived its name from parnum and affinis, because it appeared to the discoverer as a compound wholly destitute of chemical affinity.

The minerals used for the production of paraffine oils are schales and cannel coals. They are mined and brought to the surface the same as ordinary coal.

When the destructive distillation of carbonaceous minerals at a low red heat was first commenced a maximum yield of oil suitable for illuminating purposes was the point to be attained, and a horizontal retort similar in all respects to the present coal gas retort was used. No shale was worked which yielded less than forty gallons of oil per ton. After the oil produced was refined that portion only which had a lower specific gravity than .840 and which was suitable for illuminating was retained; the residue, consisting of the heavier oil and solid paraffine, was burned. Soon after the starting of the first paraffine oil works in Scotland it was discovered that the heavier oils made very suitable lubricants and that the solid paraffine, on being refined, could be made into candles. This necessitated a change in the construction of the retort, for the horizontal retort, however well adapted for the manufacture of the lighter oils, was not fitted for the preservation of the heavy oils and paraffine, owing to their unstability while hanging slowly about the hot sides of the retort. A vertical retort was then introduced, in which steam was used in its distillation. The improvement claimed was a better yield of crude oil of a better quality.

The first vertical retort was round in shape, six were set in an oven, one furnace firing them. At the bottom each retort was sealed in water and the shale was introduced at the top of a hopper closed by a bell attached to a weighted lever. Steam was introduced at the bottom to sweep the oily vapors upward to the exit at the top. The shale traveled downward, meeting a gradually increasing heat. So suitable was the retort that it was until the last few years in use in many works in Scotland, and even now the most recent retort is essentially a modification of the first vertical retort.

By the destructive distillation of shale crude products are obtained—crude paraffine oil and ammonia liquor. The latter is used for the manufacture of sulphate of ammonia. The crude oil is a greenish or brownish solid at temperatures below 80 degrees F. Chemically it is very complex, containing a very large number of distinct substances mixed with impurities. The valuable products of crude oil are burning oil, lubricating oil and solid paraffine. In appearance each is clearly distinguishable from the others, naphtha being a colorless, thin, bright liquid with a keen, persistent smell; burning oil is colorless or slightly yellow, more oily than naphtha, but still thinner than water; its smell is less pungent. Lubricating oils are yellow and have very little odor. Paraffine is white and solid.

The crude oil is submitted to chemical treatment to remove the impurities, consisting of acid and basic tars and resinous or gummy bodies. The first treatment consists of thoroughly agitating the oil with a small percentage of oil of vitriol in such a manner that every particle of oil is brought into contact with vitriol. The basic tars combine with the vitriol and separate from the oil in black globules. If the mixture be allowed to stand quietly for a few hours the separated tar settles to the bottom of the vessel and can be run off, leaving the oil clear. After the oil has been perfectly freed from the tar separated by the vitriol it is run off into another agitating tank and thoroughly stirred or mixed with a strong solution of caustic soda. This combines with the acid tars, which are substances nearly allied to creosote or carbolic acid; these also separate as a brown or black tar, which in turn is allowed to settle to the bottom of the vessel and is drawn off.

If the preceding processes are very carefully carried out the oil at this stage is nearly pure—i. e., it consists almost entirely of pure products. But they are all mixed together, each spoiling the other and preventing its being employed for its own special use. The naphtha present renders the whole mixture as unsafe as naphtha itself is, the burning oil is unfit for burning by reason of the mixture with it of lubricating oil and paraffine wax.

The first step toward separation of the products from each other is made by fractional distillation. Naphtha boils at from 90 degrees to 212 degrees F., burning oil from 212 degrees F. to 450 degrees F., lubricating oils boil together at from 440 degrees to 800 degrees F. The purified crude oil is placed in a still and the naphtha is first boiled off up to 212 degrees F. and collected, then the burning oils are boiled off, leaving the lubricating oils and paraffine to come over together. This, roughly, is the process of fractional distillation as carried on in shale oil refining and is nearly in every respect the same as in petroleum refining.

For the separation of the paraffine from the lubricating oil the process of crystallization is made use of. If solid paraffine is mixed with burning oil or naphtha and warmed the paraffine dissolves and disappears. If the solution be cooled down again to the atmospheric temperature, or, better still, if it be frozen artificially, the solid paraffine separates in crystals from the oil; and if the mixture of oil

and crystals of paraffine be placed in canvas bags and pressed the oil passes through the canvas, leaving a cake of paraffine crystals in the bag.

The lubricating oils and paraffine, which have been separated at the stills are cooled so that the crystals of paraffine separate from the oil. The cooled crystals are drained in canvas bags and pressed between iron plates in a hydraulic press, being subjected to a pressure of about 300 pounds to the square inch. These cakes of paraffine scale contain coloring matter and some oil and must be further refined to be adapted to its commercial uses. To carry out this purpose it is melted and mixed with a percentage of specially prepared naphtha. The hot solution of paraffine and naphtha is run into shallow tins, in which it slowly cools. The cakes are then turned out, wrapped in canvas and again pressed between iron plates in a hydraulic press. These operations are repeated twice or three times until the paraffine assumes the necessary degree of whiteness, after which it is melted in a still and steam blown through it to carry off the traces of naphtha, which, if left in, would give the wax an unpleasant smell. The melted paraffine is finally stirred with boneblack, filtered through paper and run into cooling tins.

American paraffine occurs in commerce chiefly in three qualities—A-B-C paraffine melting at 135 degrees, 128 degrees and 125 degrees F., respectively. The purity of nearly every wax is determined by the degree of temperature necessary to melt it—i. e., its melting point. If one wax is mixed with another wax the adulterated product always has a different melting point, hence it is that most waxes are sold according to their melting point, which is their index of purity.

In order to determine the melting point of a solid wax several different methods are in use, the results of which are not always comparable with one another, so that if an accurate comparison of two different samples is essential it is indispensable that both must be examined by the same process side by side. One of the most frequently used methods consists in preparing a capillary tube by drawing out in a flame a short piece of quill tubing; the fine end is sealed up and when cool the wax to be examined is cut into very fine fragments or pulverized and a little dropped in and shaken down into the capillary tube. This is then bound by wire or string to the stem of a thermometer so that the center of the bulb is about level with the substance; the whole is then placed in a small vessel of water, which is very slowly raised in temperature either by means of a small flame underneath or preferably by placing it inside a much larger similar vessel filled with water. The thermometer and attached tube are used as a stirrer during this heating and the temperature noted when the fragments first show signs of melting. Frequently this temperature is measurably below that requisite to cause the fragments to liquefy entirely and run down to the bottom of the capillary tube as a clear fluid.

In telephone work it is desired that the wax be as free as possible from paraffine oil, because being used for insulating purposes, the freer it is from oil the harder it is and the more firm it is the less moisture it will absorb, hence the better insulation.

In telephone cable used for certain purposes it is necessary to have a wax which has a higher melting point and possessing different properties from that of paraffine. If the higher grade of paraffine were used it would have a tendency of peeling off and not adhering strongly to the wire. Beeswax, because of its high melting point and on account of its sticking qualities, is well adapted to do this work.

The manufacture of beeswax is a simple process familiar to many. In order to obtain the wax the combs are simply drained of honey and then melted in hot water and stirred about; the wax collects on the top as an oily layer, which is removed after cooling and hardening. After remelting by heat alone, without water, and casting into blocks, the virgin wax is ready for market. The melting point of pure beeswax is 145 degrees F.

Because of its high cost, substitutes have been used or the beeswax has been adulterated with mineral waxes, and at the present time very little pure beeswax is used by the telephone manufacturing companies.

Ceresin wax is the most common adulterant or substitute for beeswax. The raw material used for its manufacture is ozokerite, a natural bituminous product occurring in many parts of the globe in the vicinity of petroleum springs. The ozokerite known best is found in Galacia. The deposits are in veins passing through sand beds, then through blue clay and a plastic loam. At first it was regarded as an unwelcome comparison to petroleum, but later this substance began to attain commercial importance, a method having been discovered of producing from it a substance resembling beeswax. The mining of this mineral is still carried on in a small way. It is raised through vertical shafts or pits, over which a wooden roof is erected to keep out the water. From the bottom of the shafts links are driven into the ozokerite ground, the richer portions being raised and the refuse used to fill up the old workings. The softer parts of the wax are dislodged by means of a pick or wedge, but if the rock is hard dynamite is used. The mineral is raised by hand in tubs holding from 88 to 110 pounds. It is sorted by hand, the waste rock picked out, lumps of ozokerite are specially selected and the remainder of the rock containing fragments of wax is thrown into tanks filled with water. On being well stirred most of the wax rises to the surface and is skimmed off. The native ozokerite is transparent, of a light yellow color and about the hardness of beeswax.

Ceresin in its physical characteristics resembles beeswax, and it is not easy to distinguish between them. Ceresin is not so easily kneaded between the fingers as beeswax and is more brittle. A mixture of these two bodies cannot be recognized in this way. Ceresin is almost unacted upon by concentrated sulphuric acid, whilst beeswax undergoes perfect decomposition. It has a melting point of from 140 to 170 degrees F. and is often adulterated with soft paraffine and bleached colophony.

THE DISHONESTY IN DISCOURTESY.

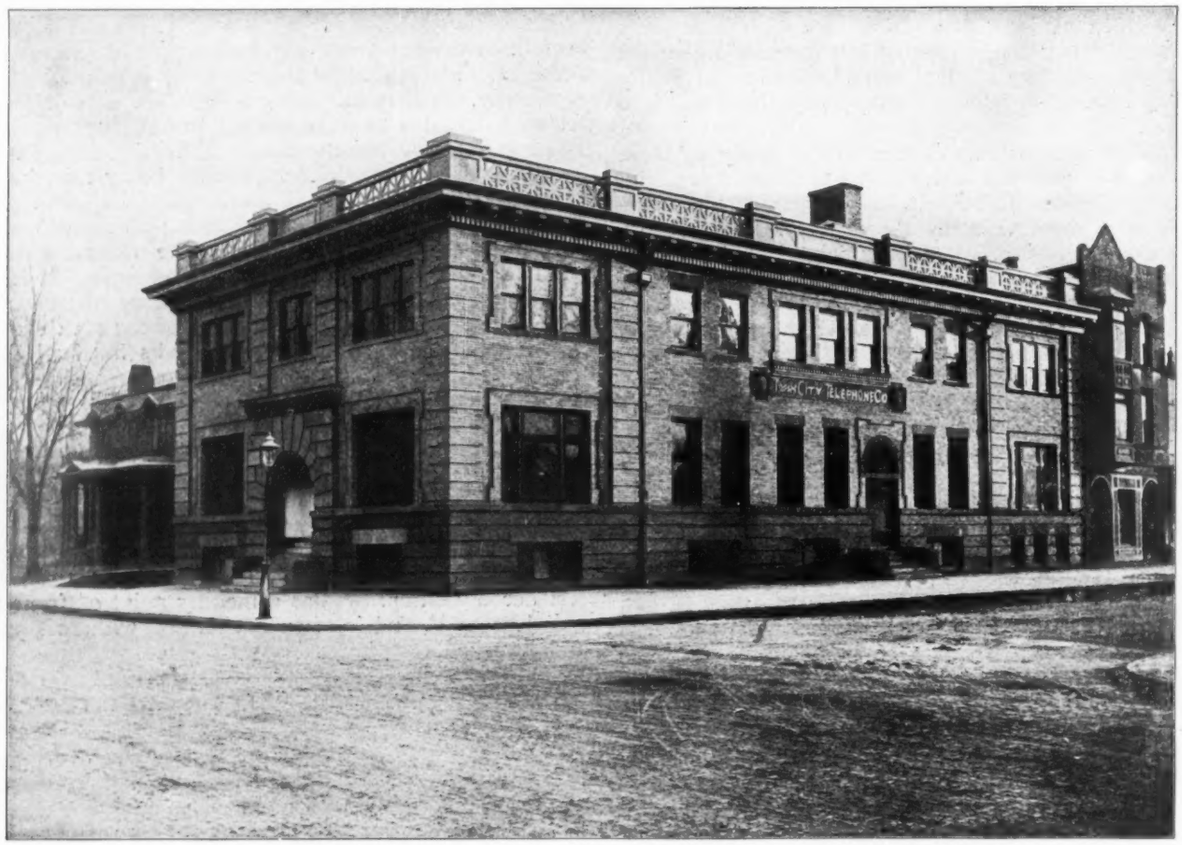
Quite naturally a telephone company endeavors to select only courteous and efficient young men and women as employes. For obvious reasons in many lines of industry, efficiency may appear more essential than courtesy. It is doubtless so in municipal or local positions, where promotion is secured through political pull and preferment. But the essential factor in operating a telephone exchange is courtesy on the part of the employes. The growth of certain telephone exchanges has been more seriously handicapped through the discourteous speech, or the discourteous action, or the discourteous neglect shown by some of the minor employes, than ever it could have been through any arbitrary action or decision on the part of the higher officials. The telephone-using public are just as quick to resent discourteous neglect as the absence of courtesy in other ways. Thus it is just as dishonest for an employe to habitually engender bitter feelings and create friction that leads to a cessation of service on the part of users, thereby reducing the income of the company, as it is to take money out of the cash drawer. And telephone users can render no better service to the company than to instantly apprise the company of every discourteous action its employes may be guilty of.

TELEPHONE SITUATION IN THE TWIN CITIES.

HUNTLEY L. HOWARD.

To those who open the pages of the telephone journals there has been revealed within the past two years the most marvelous growth of the Independent movement, marvelous in its growth not only from the standpoint of its enormous spread over the entire territory of the United States, but more marvelous because it is serving a purpose and accomplishing an end in a few years which it took a fifth of a century to develop on the part of the original Bell organization; marvelous again in that it is the most peculiar business movement that the world has ever known. It is a matter of constant wonder. The universal demand for telephone service and the small amount of capital which may be invested to bring a substantial return in the rural districts; the ease with which systems, however small, may be joined together to create other systems, and these again joined to create still others until the vastness of the aggregation outrivals even the wonderful spread of the railroad systems crossing the continent. The natural greed of a monopoly which felt itself to be beyond competition only added material for the development of the Independent movement. Beginning with the man who felt moved to give himself and his friends a little telephone service among themselves, it was ascertained that exchanges were profitable at far below the rates charged by the Bell organization. A limited amount of capital seemed willing to try its luck opposing the giant; notwithstanding persecution and bitter feeling, the idea grew that telephones could be and must be cheaper. The man who owned the exchange in the town and made it pay, felt that if he owned an exchange in the city it would pay him still more abundantly. Daring spirits entered unknown fields and in the days of doubt as to patents and litigation ever present, they cast their fortunes in the wheel against the wealth of the monster corporation and wrought the beginnings of this great and peculiar business revolution.

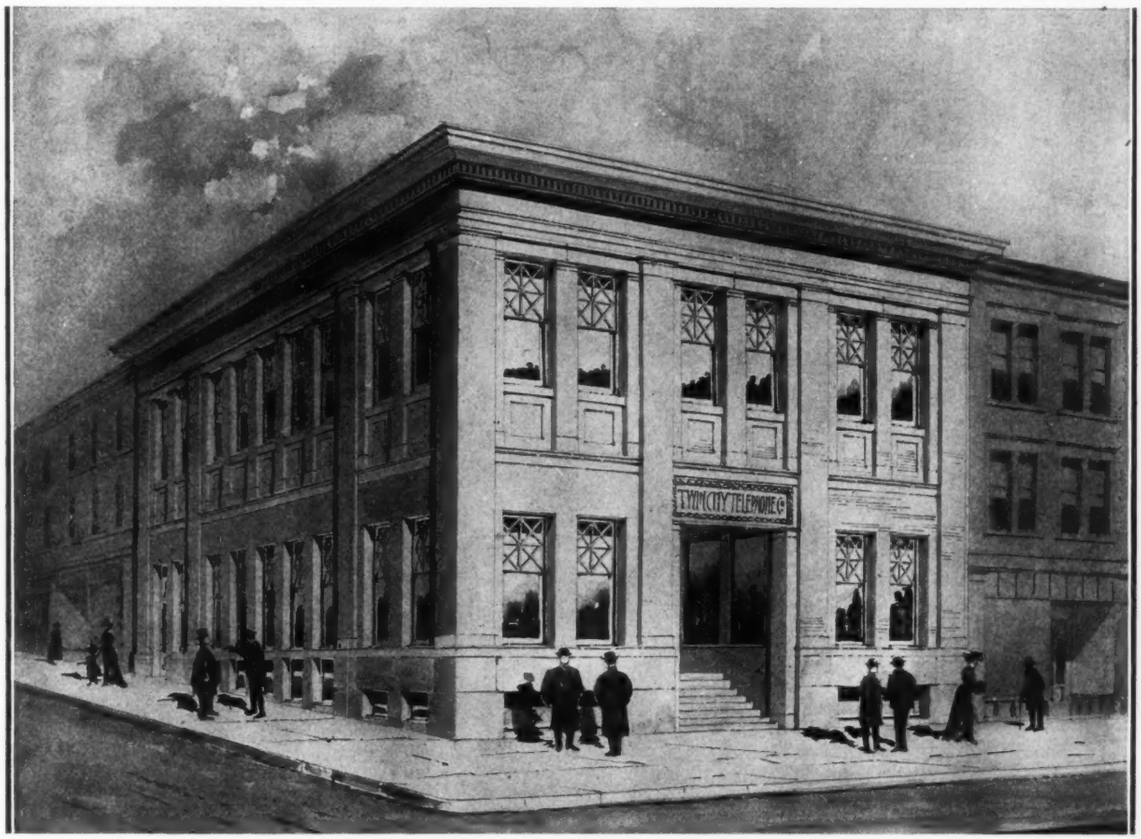
The Twin Cities of Minneapolis and St. Paul, with population of perhaps four hundred thousand, offered an inviting field for a telephone venture. As in most cities of their size and larger, the strong grip of the monopoly was here plainly discernable. Two or three adventurous individuals made unavailing efforts to secure franchises for a telephone plant, but it remained for Mr. J. C. Hubinger, of Keokuk, Iowa, already owning several exchanges in the Hawkeye state, to secure the coveted franchise. In March, 1898, Mr. Hubinger obtained his franchise in Minneapolis and St. Paul for the Mississippi Valley Telephone Company, he being the principal owner of stock in that corporation. Work was begun upon a large scale with the intention of giving what was then thought to be extraordinarily good telephone service. At that time the Northwestern Telephone Exchange Company, the Bell corporation operating in the Northwest, had approximately four thousand subscribers in the Twin Cities; the service was wretched, the plant was, with the exception of the underground work, in a decayed condition, the switchboards were old, and the advent of the rival was hailed with joy by its subscribers. As soon as the Mississippi Valley Telephone Company began work, the



NEW MAIN EXCHANGE BUILDING, MINNEAPOLIS—TWIN CITY TELEPHONE CO.

Bell Company threw a large amount of capital into its business, re-equipped both plants with common battery telephones and latest Western Electric switchboards, rebuilt a number of old lines and added a large amount of construction both underground and aerial. While the Mississippi Valley Company's franchise limited it to individual lines and unlimited service, the Bell Company introduced all the varied and extensive service that it has the reputation of using; putting telephones in on party lines for as low a price as $1.50 per month, and holding to the $7.50 rate for unlimited service business telephones on individual lines. The bait did not attract at first. The people were anxious for the new service, but they were unwilling to wait long enough for the Mississippi Valley Company to complete its plants and under pressure of an enormous force of solicitors the Bell Company acquired a large number of subscribers on the cheap lines. It was believed that in order to stop this unhealthy growth of the Bell company the Independent company should begin operations at as early a date as possible, and in about a year and a half from the time of the beginning work the Mississippi Valley Company's plant was opened for business. Within this year and a half miles of underground conduit had been laid, in the very best possible manner, miles upon miles of splendid aerial lines had been built, yet the field was so large and the necessities so great that the work was scarcely begun. Nevertheless service was opened and the Mississippi Valley Company began doing business. The demands made upon it for service were far beyond its capacity to care for; the expectations of its projector in the matter of construction and equipment were passed and it soon became apparent that the demands for telephones would be doubled and quadrupled before it could be said that the plants were fairly equipped. The service of the company was exceptionally good and, early in the year 1901, realizing that the Independent telephone business in the Twin Cities would become gigantic, a home corporation was organized under the name of the Twin City Telephone Company, a large amount of other capital was secured, and into this company was merged the Mississippi Valley Telephone Company. The original plant was enlarged to meet the enormously growing demand and the changes were of necessity so great that it was like engineering a new project. The work of the Mississippi Valley Company had been exceptionally well done and no rebuilding was necessary, but the switchboards had been designed for necessities far smaller than it was now found existed and an entire new equipment for both cities was planned. New buildings were erected both in Minneapolis and St. Paul for the main and branch exchanges, large and far reaching extensions to the underground system were begun and carried on throughout the year. Additional miles of pole lines were built and everything possible was done to rush the work of supplying the needs of the subscribers.

When the Twin City Telephone Company took over the plant of the Mississippi Valley Company it was serving in the two cities 2,700 subscribers. The Mississippi Valley Telephone Company, as many Independent companies have done, was serving a large number of its subscribers without charge. Advantage was taken of this action to create an enormous free list. The Twin City Telephone Company had no sooner begun work than it was deemed desirable to reduce this free list, and it was accordingly cut off. This reduced the number of subscribers somewhat, but the increase of paying subscribers was so rapid that it was not and has not since been possible to keep up with the demand.



MAIN BUILDING, ST. PAUL—TWIN CITY TELEPHONE CO.

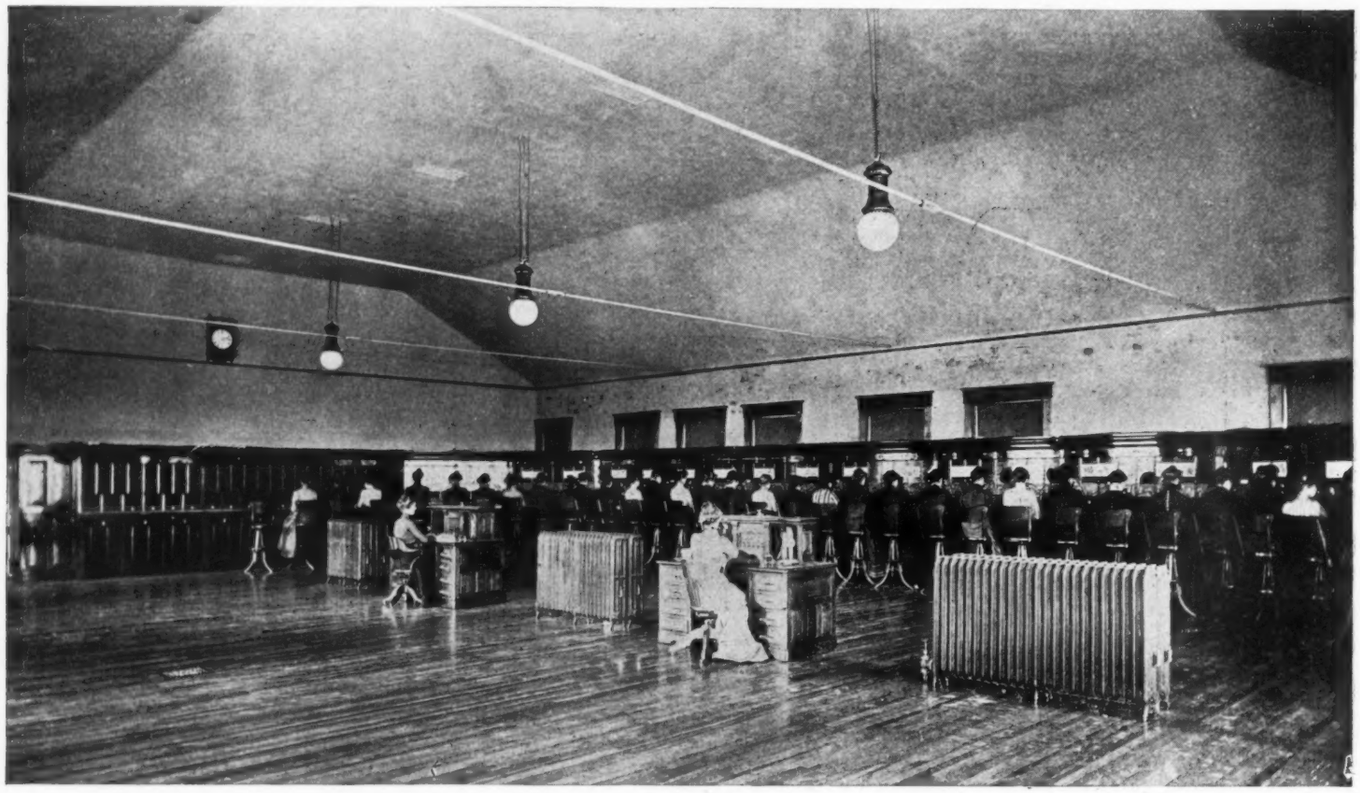
At the present time the Twin City Telephone Company is serving about eight thousand subscribers in the Twin Cities, all on individual lines and all cash subscribers. It was found necessary early this year to reduce the force of solicitors to a minimum owing to the inability to keep pace with their work, and while there is no decrease in the demand for telephones, equipment is being added so rapidly that it is ex-

pected there will be comparatively little inconvenience from this time on account of lack of facilities.

The growth of the Twin City Telephone Company has been somewhat different from that of other large companies but has not been of the "mushroom" kind. There has been no effort made to secure trial subscribers except in St. Paul, where a small list was given a trial at the urgent request of some of the older subscribers, and the company is solidly committed against any subscriptions of that nature. All contracts have been taken for one year or more and no telephones are placed under any other conditions. The opposition is not so restricted. The cheap party line telephone, the measured service telephone and all the various devices for increasing the directory of the Bell company were resorted to, not without success until in the early part of 1902, when it began to be discovered by certain Bell subscribers that some of their connections were missing. The disaffection is becoming more and more apparent from day to day. Since the absorption of the Northwestern Telephone Exchange Company by the American Telephone & Telegraph Company, in the Western Telephone & Telegraph Company, renewed efforts have been made to coax, wheedle and bribe the public to become its patrons. Changes in service have been inaugurated and reinaugurated and tried again and again, but through all of this the Twin City Telephone Company goes steadily on, growing not like the beanstalk, but more like the oak, getting stronger every day, backed up by a plant which is the equal of any and the superior of most telephone plants in this country. To the officials of the company belongs the highest credit for the far-sightedness which has been displayed in deciding that solidity and permanence rather than an ephemeral boom should be its aim. The officers of the Twin City Telephone Company are as follows:

President, Eder H. Moulton, Minneapolis; vice-president, Joseph Lockey, St. Paul; secretary-treasurer, Wm. M. Kerkhoff, Minneapolis; general manager, Edward E. Webster, Minneapolis.

These gentlemen are well known business men of the Twin Cities, the president and vice-president being heads of banking houses long ranking foremost in the Northwest, and the treasurer being a man of experience in financing large enterprises. The general manager, Mr. Edward E. Webster, is an old resident of Minneapolis and possesses an enviable reputation for business push and integrity. Associated from the very first with the Twin City Company and with its predecessor, the Mississippi Valley Company, in its Minneapolis business as general counsel, he is peculiarly fitted to manage its commercial affairs. His careful study of telephone conditions throughout the country has enabled him to grasp the situation with a broad comprehension, and his grim determination to make the Twin City a winner in spite of all opposition has made it the successful public servant that it is. It has been a fight, not of the spectacular kind, but a carefully planned, quiet, under-the-surface contest against a well equipped and cunning opposition. That the fight is being won is only too well proven by the condition of the Twin City Telephone Company to-day. The addition of 4,600 subscribers during the eighteen months' life of the Twin City Telephone Company is sufficient proof that the company is not only well grounded but is thoroughly popular. Popularity in the telephone business is the result of a cold-blooded system of reasoning. Sentiment cuts little figure in the proposition. The factors which make for popularity in a telephone company are, first: good service; second, reasonable rates; third, courteous consideration of the wants, rights, and feelings of the telephone user. The motto of the Twin City Telephone Company has always been "the best is none too good," and not only does it want the best lines, the best equipment and the best talk, but the best switchboard service which can be produced under any conditions.



MAIN SWITCHBOARD, MINNEAPOLIS—TWIN CITY TELEPHONE CO.

The designing of the entire plant, including every detail of buildings and equipment and the execution of all work has been in the hands of Mr. Clarence H. Judson, the general superintendent. Mr. Judson has been extremely fortunate in the selection of his chiefs of departments and the

harmonious whole is no better exemplified than in the technical departments of this company. The general superintendent is also directly in charge of maintenance and operation and these departments are wisely and economically conducted. Good service and good maintenance means much and involves in a large company an enormous amount of detail and a perfect organization. The Twin City Telephone

SOUTH BRANCH, MINNEAPOLIS—TWIN CITY TELEPHONE CO.

Company is happy in the reputation for doing things right.

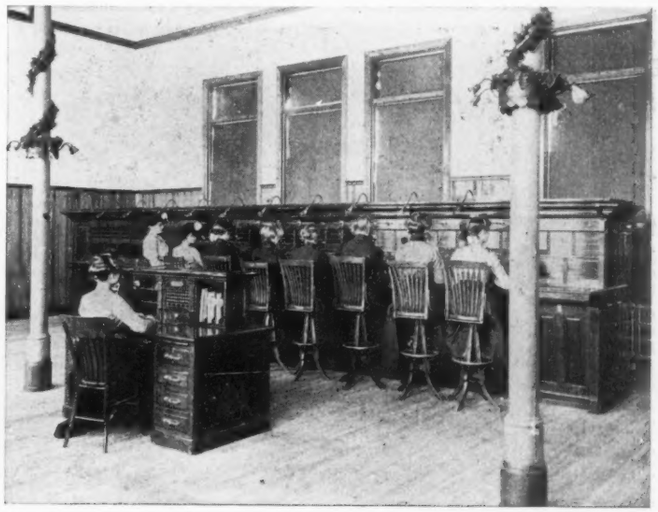
It is not the purpose of this article to simply show what some telephone engineer has done in the way of construction, nor to show what some manufacturer has done in the way of equipment, but rather to give to the Independent telephone man a fair idea of the growth of a representative company; to show what has made it what it is and to show what constitutes a high grade plant.

It is not necessary to discuss the details of the preliminary work, but the article would be valueless without a description of the physical plant as it stands to-day.

The plant of the Twin City Telephone Company comprises about 8,000 miles of wire in aerial construction, about 1,500 miles of wire in aerial cable, and about 25,000 miles of wire in underground cable. The underground conduit construction of the company aggregates over 1,200,000 duct feet of conduit and several miles of tunnel. All this construction is of the very best, the conduit being mostly McRoy in multiple ducts. The cable is composed of No. 19 B. & S. G. conductors, double wrap, conference specifications. Nearly all of this cable was manufactured by the John A. Roebling's Sons Company, part of it, however, being from the mills of the Standard Underground Cable Company.

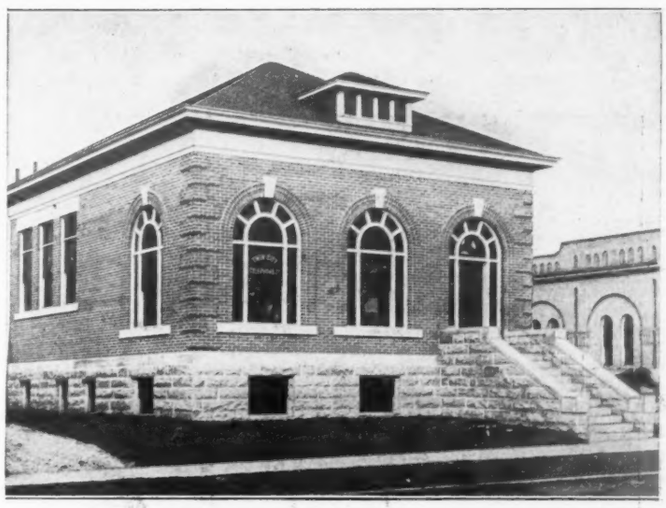
In the aerial construction very few short poles have been used, the great bulk of the poles run above forty-five feet in length, very many leads being supported entirely on poles longer than fifty-five feet. Two leads, each more than two miles long, are supported entirely on sixty foot poles. A ten foot, twelve pin cross-arm is used universally, the construction in all respects being standard throughout the plant, there being no variation in the size of poles or cross-arms or the size of wire, except for toll line work outside of the cities. All cross-arms are bolted to the poles with five-eighth inch machine bolts and all double arming is done by the use of a double threaded steel rod instead of the almost universal wooden block bolted through. This method of double arming has been found vastly superior to the wooden block method. All distributing poles in the business districts of the city are equipped with the Gregory circle, manufactured by the Therien Tool Works, of Minneapolis, with a large and capacious header box, covered by a four-foot canopy, and equipped with American porcelain fuse blocks. All terminal poles are equipped with specially designed cable boxes and balconies, the boxes being securely fastened by double slide bars and locked with a special strong brass padlock. These cables are equipped with the same protectors as the header boxes on the circles.

Minnesota is a state of fierce thunder storms and the effi-



SOUTH BRANCH EXCHANGE—TWIN CITY TELEPHONE CO.

ciency of the protection used by the Twin City Telephone Company is proven by the statement that not one telephone has been lost from lightning by this company, the utmost damage done being short circuiting of the condensers now and then. In the making up of the cable terminals okonite wire has been used exclusively for pot-heading and a specially designed wire manufactured by the John A. Roebling's Sons Company for the bridles. All distribution to

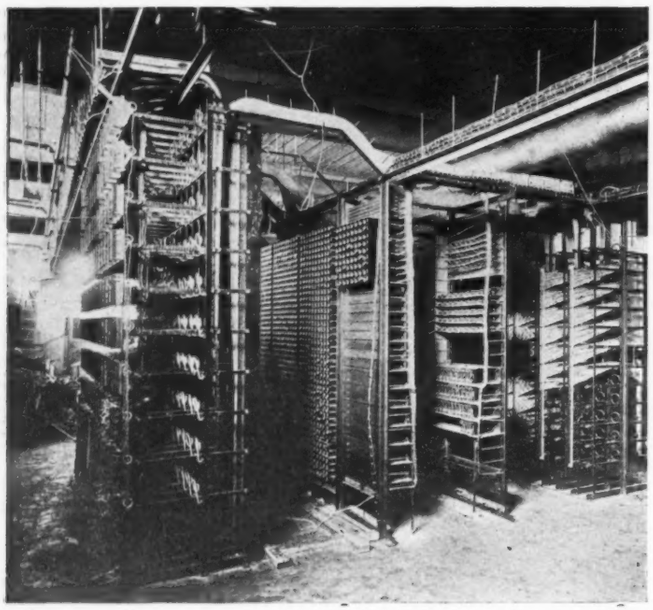


DALE BRANCH, ST. PAUL—TWIN CITY TELEPHONE CO.

telephones is accomplished by the use of twisted pair No. 14 rubber covered copper braided wire. B. B. No. 12 iron wire is used for all city lines except on long lines, where No. 10 and No. 12 hard drawn copper is used, copper being always used in crossing over railroad tracks or where sulphurous fumes abound.

In the underground construction ample space has been given in all manholes for carrying cables, most of which run to large sizes. The multiple system of distribution is used moderately, an ample margin being allowed for increasing any of the runs, and multiples covering long lines being particularly avoided. The wire plant of the Twin City Tele-

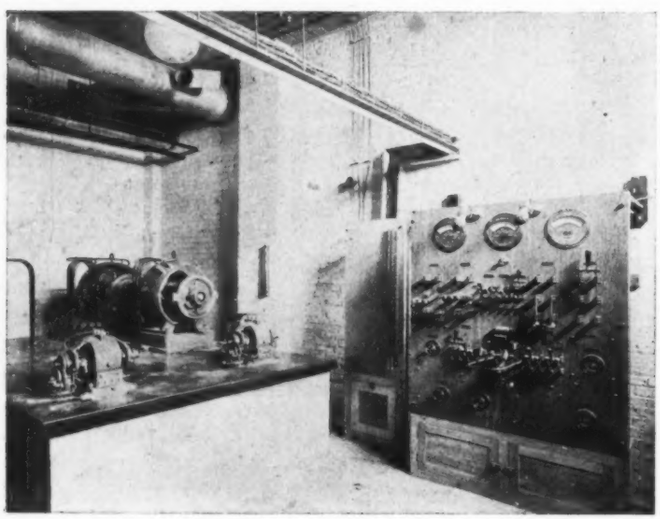
phone Company has been pronounced by Bell as well as by Independent experts to be as nearly perfect as any in the country, both aerial and underground. A peculiar innovation made by this company is the iron distributing poles used in residence districts where the heavy cedar pole and large circle with platform would be inadvisable. This pole is very ornamental and is usually set in the street, the pro-



TERMINAL ROOM, MINNEAPOLIS—TWIN CITY TELEPHONE CO.

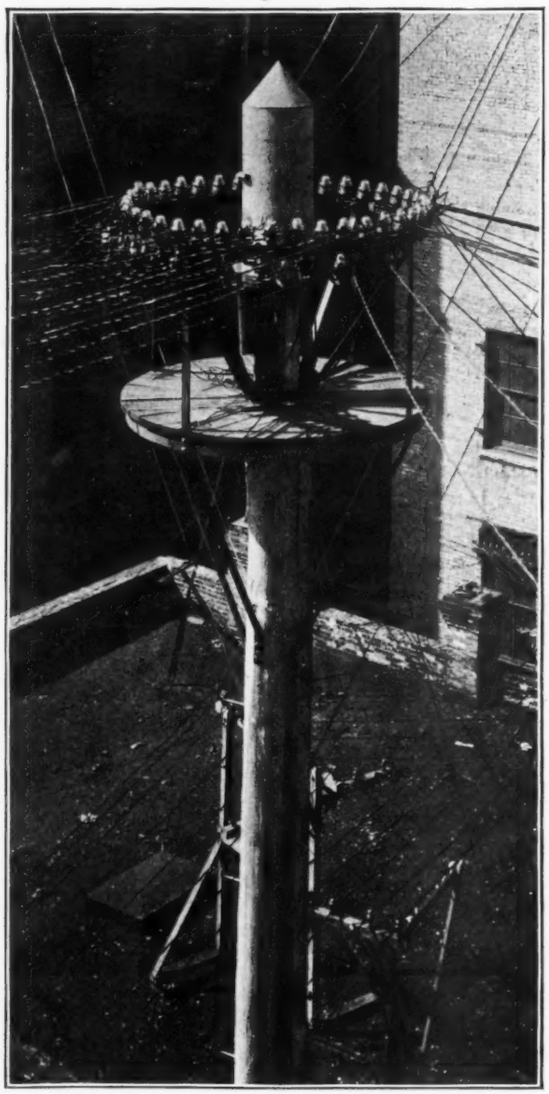
tecting apparatus being enclosed in the square pedestal, okonite jumpers running up through the hollow pole to the circle. These poles have proven very satisfactory in all weathers and are in no way an injury or disfigurement to the most beautiful streets.

The company owns four of its exchange buildings and is about to erect another. Two of these buildings are main exchanges, one in each city, and two are branch exchanges.



MAIN POWER PLANT—TWIN CITY TELEPHONE CO.

The main exchange building in Minneapolis contains not only the exchange equipment, but the general offices of the company. It is a very handsome building and is situated at the corner of Third Ave. South and Seventh street, apart from the busy, noisy portion of the city, but on the direct line of the main conduit lead, which is in the form of a quadrangle running around the business center. This building is constructed of light buff pressed brick, and strikes the passer-by most favorably, resembling as it does a club house in appearance and possessing none of the ear marks of the ordinary business block. It is a veritable hive of industry, for within its walls during each business day about one hundred persons are employed in various capacities. The building was designed after a careful and thorough study of the newer telephone buildings of the country, coupled with the experience of years, and may fairly be stated to represent the ideal telephone headquarters. The first floor of the building is occupied by the offices of the company, the main operating room and operator's quarters being on the



DISTRIBUTING POLE—TWIN CITY TELEPHONE CO.

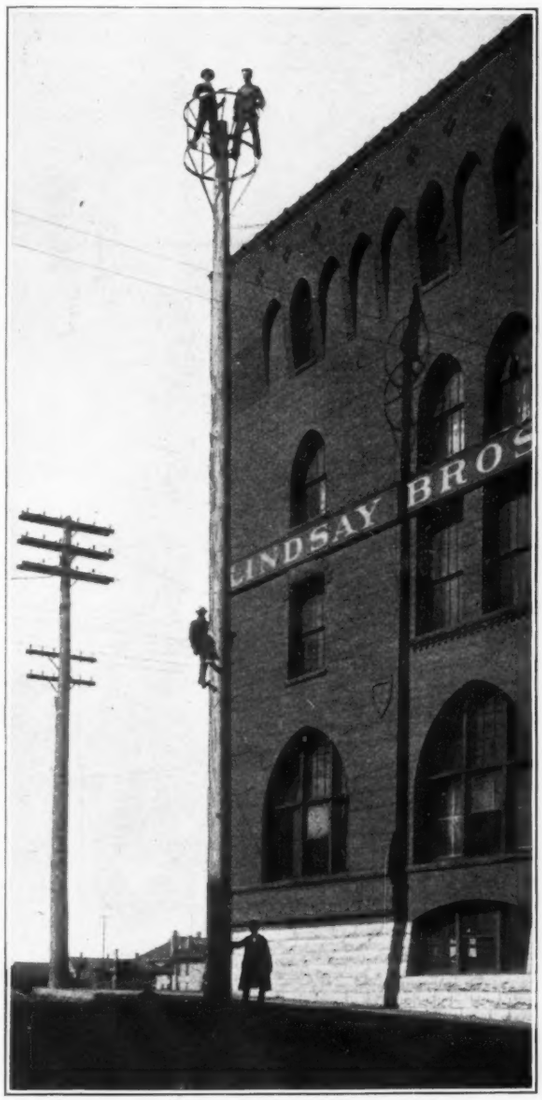
second floor. The operating room is 50x70 feet in size and adjoining it on the same floor are the operators' sitting rooms, lunch room, lavatories and locker room. This latter room is equipped with expanded metal lockers of the most sanitary type, and it may be said here that all lockers used by the company are of the same pattern, not only those used by the operators, but also the lockers used in the other departments of the various buildings.

In the operating room is installed a switchboard manufactured by the Stromberg-Carlson Telephone Mfg. Co. of Chicago and Rochester.

In this room is also installed the toll line switchboard, it being a multiple toll board with present line capacity of

thirty lines, and equipped with the latest and most approved devices for handling toll line business including the ever necessary calculagraph. The trunking circuits from this board to the main board were especially designed and give the operator absolute supervision over the connections, supervisory lamp signals operating positively from the central energy lines, and clearing out drops for the through toll line connections.

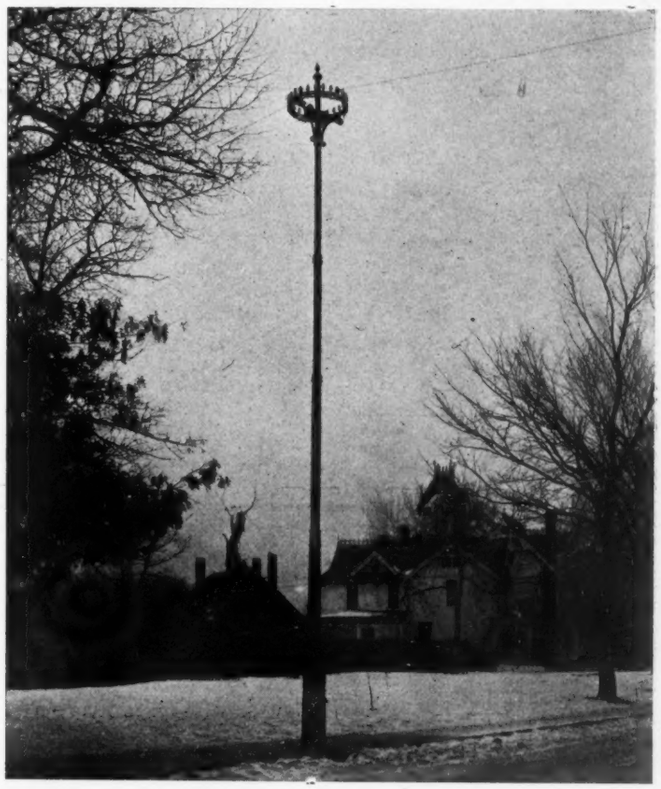
The switchboard is known as a multiple relay lamp-line signal central energy switchboard, as shown in illustration. Sixteen sections of three operators' positions to each section, are provided with provision for an ultimate accommo-



DISTRIBUTING POLE—TWIN CITY TELEPHONE CO.

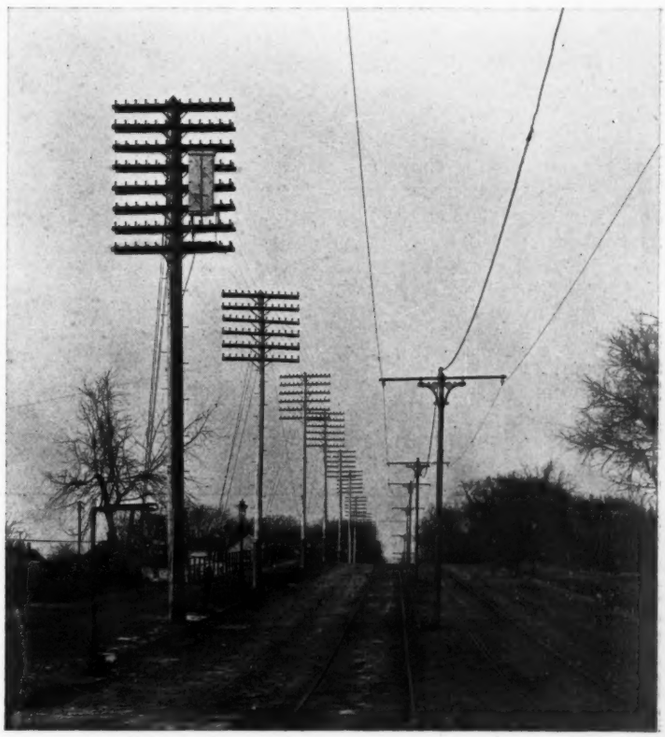
dation of twenty-five sections. The present capacity of the switchboard is for 3,440 lines, providing for an ultimate of 7,200 lines.

A complete trunking system has been installed between the various exchanges consisting of the Minneapolis Main Exchange, its three branch exchanges, North, East and South, likewise St. Paul Main Exchange and its two branches—the Dale Street and Marion Park. The system is such that a subscriber in any one exchange can have direct connection with a subscriber in any other exchange by means of direct trunks and in such a manner that no greater delay is occasioned in having connection with subscribers in other exchanges than is occasioned in having connection established with subscribers in their own exchange. These trunks are handled by a separate set of operators. The sub-



IRON DISTRIBUTING POLE—TWIN CITY TELEPHONE CO.

scriber gives the number he desires to his regular operator, who transmits the order over an order wire circuit to the



POLE LEAD—TWIN CITY TELEPHONE CO.

regular trunk operator at the distant exchange, who completes the connection and rings the desired subscriber.

The outgoing trunks for each of the other exchanges are multiplied in each section and each operator is further equipped with a set of order wire keys for ordering up connections on each of the other exchanges. The incoming trunks terminate in front of the trunking operators on plugs

E. H. MOULTON, PRESIDENT.

and cords with associated guard, and disconnect lamps and likewise ringing keys. The operation of the trunks are automatic. When the called subscriber answers, the guard lamp in front of the trunking operator and likewise the calling lamp on the regular exchange operator's cord pair both go out and remain out until the conversation is completed. When the called subscriber hangs up his telephone, the regular exchange operator is notified by the supervisory lamp on the cord pair burning, and as soon as she takes the connection down a disconnect lamp lights in front of the trunking operator, which is a signal for her to disconnect. The operation of the trunking system is so complete and positive in its action that there is nothing to indicate to the subscriber that a special connection is required in order to have a connection with subscribers in distant exchanges.

The first five sections of a switchboard are used for incoming branch exchange trunk lines and have an ultimate capacity of four hundred and thirty-two lines. The first position of the sixth section has an equipment of one hundred lamp line signals and a corresponding number of answering jacks; the second position of the sixth section has an equipment of one hundred and twenty lamp line signals and a corresponding number of answering jacks; the third position of the sixth section has an equipment of one hundred lamp line signals and a corresponding number of answering jacks. The remaining ten sections are equipped in the same manner as the sixth section. Each of the regular equipped operators positions in addition to the above line equipments, have fifteen pairs of connecting cords, double lamp supervisory signals, fifteen platinum contact ringing and listening keys, two pilot lamps one operator's head telephone complete, together with relays and associated apparatus.

The arrangement of a regular subscriber's section consists of mounting in the upper part of the front of the board, 3,440 multiple jacks, in banks of one hundred and providing space for the ultimate accommodation of 7,200 jacks. Below the multiple space are installed, the trunking jacks for the monitor, chief operators' and wire chiefs' desks, with space for the ultimate of three hundred and twenty outgoing trunks. Immediately below this space are mounted alternately the combination answering jacks and lamp line signals in strips of ten. The jacks and lamps are mounted alternately, so that the answering jacks appear immediately below the corresponding line signals. Three hundred and twenty line equipments are provided for each section. The line-call pilot lamps and ringing supervisory lamps are mounted in a leather faced panel immediately below the answering jacks. The plugs and cords are mounted in the plug shelf and key-shelf in the standard manner. Two operators' jacks are provided for each operator's position.

The key-shelves are hinged and made up of five layers of wood, glued together, the grain of the two outside and central layers running lengthwise, and that of the two other layers running crosswise, thus preventing warping. The plug shelves are covered with heavy belt leather, one-eighth of an inch in thickness which greatly lessens the wear on plugs.

The frame of the switchboard is made of structural steel strongly braced. The cabinet work is made of quarter-sawed oak and finished in golden oak, presenting a very

JOSEPH LOCKEY, VICE-PRESIDENT.

striking appearance. The face of the board is illuminated with electric lights mounted directly on the switchboard by means of duplex lamp brackets providing one bracket for each alternate operator. Lamps are also provided on the interior of the switchboard to facilitate the proper inspection and care of the switchboard apparatus.

A monitor's desk and chief operator's desk are provided in this room. The cabinet work here is also of quarter-sawed oak and finished in golden oak. The chief operator's

desk is provided with three regular exchange lines and lines to the wire chief's desk, monitor's desk, trouble-clerk's desk and the general superintendent's desk, together with necessary line lamps, answering jacks, plugs, cords, keys and pilot lamps, one set for each equipped operator's position, likewise with exchange lines, supervisory lines and cord equipments for the proper operation of the board.

EDWARD E. WEBSTER, SECRETARY AND GENERAL MANAGER.

The monitor's desk has a tap from each operator's head telephone circuit, connected with a monitor key on this desk. The desk is also provided with terminals for one line each to the chief operator, wire chief and trouble clerk's desks, together with the necessary lamps, answering jacks, plugs, keys cords and complete talking apparatus. The monitor lamps mounted on this desk are connected with the pilot lamp circuit of each operator's position on the main switchboard, and are wired in in such a manner that they light and remain lighted so long as any lamp signal on its corresponding operator's position remains lighted. This serves as a supervision over all incoming calls in the exchange and makes connections very rapid.

A wire chief's desk is installed in the terminal room and is equipped with exchange and intercommunicating lines, likewise trunks to the main switchboard and test lines to the main distributing frame for testing out on the subscriber's lines, and also on the switchboard side of the frame. Testing apparatus is provided for all desirable tests required in the operation of a modern telephone system.

In the basement of this building is the terminal room. This room is an ideal one for the purpose, fourteen feet high, thirty feet wide and sixty feet long. In it is installed the main and intermediate distributing frame, relay racks and power plant. A combination main relay rack and intermediate distributing is provided and installed in sections of eight hundred line equipments each, assembled side by side in such a manner as to make a very compact system of racks and very conveniently arranged for access to any part of the apparatus mounted thereon. The compactness of the arrangement is illustrated herewith. Five sections of combination racks are installed, providing for immediate assembling of apparatus for 4,000 lines with necessary provisions for increasing to the ultimate capacity, 77,200 lines. The underground cables are terminated on the horizontal side of the main distributing frame. Combination lightning arresters of the carbon type and sneak current arresters of the heat coil type are mounted on the vertical side of the main distributing frame in strips of two hundred pairs each. The relays are mounted on iron mounting strips of twenty pairs per strip, protected both from dust and inductive disturbances by means of removable shells. These relays are mounted in bays of four hundred per bay.

The intermediate distributing frame is provided for mounting on the multiple side, two hundred pair strips and on the answering jack side one hundred pair strips, properly numbered to correspond to the answering jack panels and the multiple jacks respectively. All cabling between the racks and from the intermediate distributing frames to the switchboard on the floor above, is done overhead as shown in illustration.

The storage battery which is one of the most complete telephone storage batteries ever installed, consists of two sets of twenty cells each, of the chloride type, contained in lead lined tanks, which are located in a room constructed under the sidewalk on the Third avenue side. The battery has sufficient capacity for doing the following work: Lighting the entire exchange building eight hours, running ventilating fans two hours and furnishing current for a 7,200

POLE LEAD—TWIN CITY TELEPHONE CO.

line board twenty-four hours, all without recharging.

The power switchboard, charging machines and ringing machines are located in the power room, as shown in illustration. The power board is made of Italian marble mounted on an iron frame equipped with Weston flush type voltmeter and ammeter, automatic overload and underload, circuit breaker, likewise the necessary switches, fuses busbars, rheostats and starting boxes.

The power plant consists of two 16 H. P. twin set charging machines running on a two hundred and twenty volt circuit, two ringing machines, all built by Roth Bros. & Co., Chicago. Each ringing machine is provided with busyback, howler, and intermittent ringing attachments. The machines are mounted on power tables arranged conveniently for operation.

On this floor is also the heating plant, as well as the inspector's quarters and the equipment store room. The entire space under the sidewalk on the Seventh street side is occupied by storage vaults. Every device for the complete control of the system has been installed in this building, even to the Bristol recording ammeter in the office of the general superintendent which shows him at any hour of the day or night with a remarkable degree of accuracy the battery "pull" on the switchboard. This record is as valuable to him as the peg count, and its permanence renders it a particularly choice addition to his office files.

The building is heated by steam and the operating and terminal rooms by indirect radiation supplied by a large fan in the boiler room. The air is forced through a water spray thoroughly cleansing and purifying it, and is heated to exactly the right temperature in winter and cooled in summer. Exhaust fans carry the foul air off the floors throughout the entire building. Regulation is automatic, thermostats being placed in each room.

The main exchange equipment of St. Paul is practically the same as that in Minneapolis, the difference being only in the smaller office space, the operating room being the same size, the swichboard but a trifle smaller, but of exactly the same pattern and ultimate capacity.

The branch exchanges of the Twin City Telephone Company are as follows: In Minneapolis, North Exchange, East Exchange and South Exchange; in St. Paul, Dale Street Exchange and Park Exchange.

The Minneapolis South Exchange and the St. Paul Dale Street Exchange are installed in the company's own buildings, being miniatures of the main buildings and containing all the exchange equipment and apparatus necessary for the carrying on of a complete exchange business, the operators' quarters and inspectors' rooms being ample as in the main. The Minneapolis North office will soon be housed in its own building. The Minneapolis East office occupies quarters in the Chute Block at University and Central avenues, and the St. Paul Park office is permanently quartered on St. Anthony avenue in Merriam Park. The ultimate capacity of these boards is 3,600 each. The total ultimate capacity of the switchboards in Minneapolis and St. Paul is about 32,000 lines. All of the switchboards and the apparatus used by the Twin City Telephone Company was manufactured by the Stromberg-Carlson Telephone Mfg. Co. The engineers of the Twin City Telephone Company have taken extraordinary precautions to secure the very best results from the equipment and their efforts have been heartily co-operated in by the manufacturing company. The result is an installation which is claimed to be nearly perfect.

The peg count of the Twin City Telephone Company at the present time shows about 90,000 calls answered each day in its various offices. It has gained so rapidly from month to month that it is impossible to predict what it will be a few months from now. The company has installed in Minneapolis and St. Paul something over seventy private branch exchange switchboards, many of which have a large number of lines running to outside stations, and from which

POLE LEAD—TWIN CITY TELEPHONE CO.

POLE LEAD—TWIN CITY TELEPHONE CO.

no count has ever been made. It is impossible to say what the peg count would be if all these stations were connected direct with the company's central switchboards. Certain it is that the business of the company is growing at a remarkably rapid rate, and since there is no reason for its decrease, and every reason in the world for its increase, there can be but one thought for the officers and that is, can they keep the construction up to it? It never expects to complete its work, and with the present growth continued for ten years the result is impossible to forsee.

The Twin City Telephone Company owns no toll lines except those connecting the two cities and some short lines running to adjacent towns, but its associate companies, the Consolidated Telephone & Telegraph Company, the Rapid Service Telephone & Telegraph Company, and the Minnesota Valley Toll Line Company have about two thousand miles of No. 10 copper lines, one line connecting the Twin Cities with Duluth and West Superior, another running East and Southeast and another running along the Minnesota River to Mankato. Its toll lines are built in the best possible manner, of the very latest approved construction, and with ample pole capacity to carry a large number of additional wires, three circuits being the least carried upon any line at the present time. Transmission over these lines is perfect and the business of the lines is remarkably good. All of the lines terminate at points where prosperous Independent exchanges are in existence and tapping many other Independent plants enroute. Mr. E. H. Moulton, president of the Twin City Company, is the controlling owner of these lines.

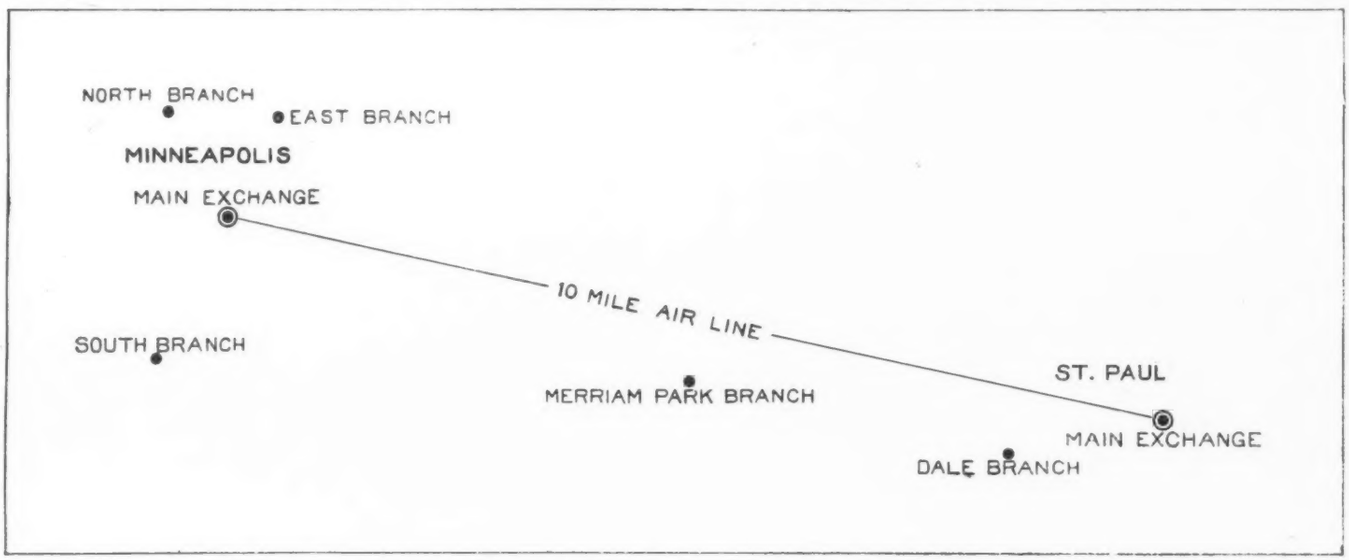


DIAGRAM SHOWING ARRANGEMENT OF TWIN CITY EXCHANGES.

The officers of the Twin City Telephone Company believe in a community of interest among the Independents, and while at the present time there is an enormous reaching out in the state of Minnesota after Independent exchanges by the Bell Company, the better of the plants are not passing over to the monopoly and wherever the Twin City Telephone Company, or its associate companies have built, it has been received cordially and has been in no way hampered in its business operations, except, of course, as the opposition by its schemes and contrivings have tried to hamper it. The plants of the company are built for time and not for to-day and from the first to the last they are distinctly up to date, an example of what first-class telephone exchanges should be.

Nine hundred telephones have been installed in the Palace Hotel, San Francisco, and thirty miles of wire has been used in putting in the system.

THE PROFIT IN ANSWERING PROMPTLY.

The value of telephone service would be materially enhanced if telephone users could only lay aside personal feeling long enough to perceive that by replying promptly to the telephone call advantages accrue to themselves which are many times greater than the benefits derived by the telephone company. Of course, failure on the part of the called subscriber to respond promptly not only lowers the average efficiency of the service and necessitates extra work and watchfulness on the part of the operator, but it does more. It hurts the company; but the injury inflicted on the subscriber who fails to respond quickly is likely to be more serious and more expensive to heal.

For to neglect to answer promptly the call at the telephone door has the same effect as though a good customer was allowed to stand and knock at the main entrance to the store because the door happened to be locked during business hours. In the latter event how quickly the merchant opens the door and how profuse his apology for such a stupid blunder. But does the merchant ever apologize to the customer who stands knocking at his telephone door? Yet the merchant wrongs the latter deliberately. For the caller's telephone door is also locked while awaiting the merchant's convenience.

Many a merchant receives more orders through his telephone door than ever came in over the counter. One merchant who comprehended the profit-producing qualities of the telephone has built up a thriving business in Chicago simply through the watchful care he gave all telephone orders. Instead of sending solicitors out each morning to the residences of desirable customers, he employed a couple of bright, intelligent young women to solicit orders over the telephone and to carefully enter all telephone messages. He now says that these two telephone clerks soon had a greater volume of business entering his establishment than any of this competitors could control. And now he has four telephones in service.

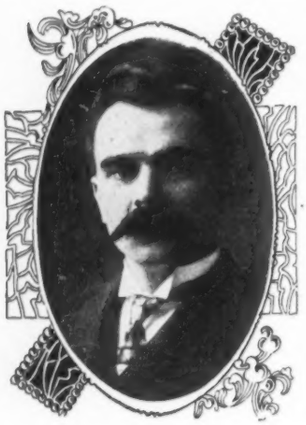
But he never made the mistake of having his clerks use both telephones at the same time for outgoing calls. He endeavored to always have one telephone door open so that customers could enter and make known their wants. And his instructions to every one in his employ are: "Responding promptly to a telephone call is only common courtesy; and courtesy, even to a telephone caller, may pay a very handsome profit."

PRACTICAL TELEPHONY

Conducted by P. KERR HIGGINS, A. M. I. E. E.

ARTICLE III.

Transmitters.—Telephone transmitters have passed through many transformations before arriving at their present stage of development. It would probably be interesting and instructive to study the different forms, but we will confine ourselves to the two forms almost universally used, —namely—the "Blake" and the "Solid Back" or granular type. The "Blake" style (Figs. 1-2) is based on the principle of the original Hughe's microphone. This style of transmitter, when properly adjusted and battery up to standard, gives the most perfect transmission, the tone quality being absolutely pure. It has, however, two defects: 1. Too weak for long distance transmission; 2. easily put out of adjustment. This form of transmitter is so well known as not to need detailed description. The frame work is formed of an iron casting fixed to the door of a wooden box which encloses the whole. The casting is of two parts, as shown in Fig. 2, a fixed and an adjustable part; on the adjustable part is suspended the carbon button A, and the German silver spring Z; on the fixed part is the diaphragm



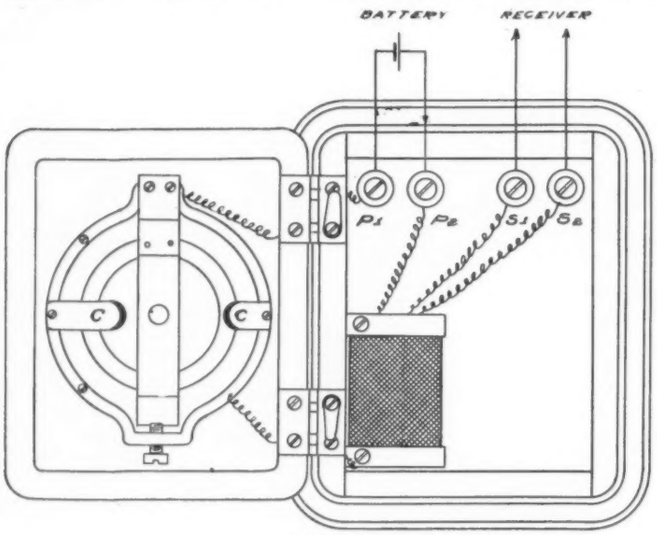


FIG. 1.

(D), composed of sheet iron, its edges being insulated from the main casting by a rubber ring. This diaphragm is set in a recess in the casting and is held in place by cushions c, composed of steel spring with rubber and felt cushions on the ends and fastened into the casting by means of screws. The German silver spring (Z) is insulated by two strips of fiber. At the point where the spring comes between the diaphragm (D) and the carbon button, is a double contact point of platinum which presses against the center of both diaphragm and button. The solid carbon button is inserted into a brass socket. The spring F is so set as to throw the contacts away from the diaphragm and by adjusting the screw G, the distance can be regulated to a very fine point.

In the back portion of the wooden box is placed the induction coil and the terminals or binding posts, and connection between these and the casting is made by means of the hinges, which are reinforced by the contact plates, so as to insure a good rubbing contact. The circuit can

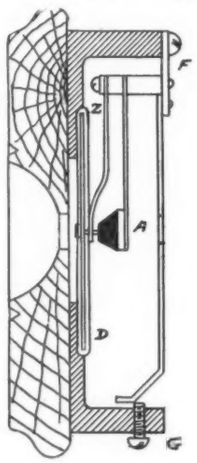


FIG. 2.

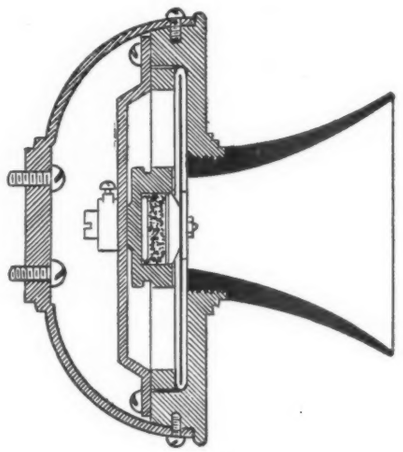


FIG. 3.

readily be seen from Fig. 1. It may be observed that this transmitter can only be used in an upright position and on a firm back, or wall, and this latter must be absolutely free from vibration of all kinds. Where this cannot be obtained the transmitter must be suspended on rubber bands, one at each corner, and arranged to keep it free from contact with the wall or back-board. The principle of this, as of all carbon transmitters, is that the resistance of this element to a current varies in proportion to the pressure exerted on the contact points, so that if a battery current is sent through the contacts, as shown in diagram 1, the current will be steady, if there are no vibrations at the variable contact; but, if the mouth-piece, Fig. 2, be spoken into, vibrations are set up at the contacts and fluctuations will result and will repeat themselves in a receiver connected in the secondary of the induction coil at s_1, s_2, Fig. 1. It will be noticed that the brass holder for the Blake carbon button is very essential in the construction of this style of transmitter, because it is too ponderous to follow closely the rapid vibrations which take place in the diaphragm, and it also exerts a heavy pressure on the carbon.

Induction Coil.—It was shown in a previous paper that variations in current produced in a primary coil will reproduce themselves in a secondary coil wound over the primary. The induction coil usually consists of four parts: 1. The spool. 2. The iron core. 3. The primary winding. 4. The secondary winding. The spool is generally made of wood and will be made in proportion to size of coil. An electro-magnetic circuit is formed in the primary by using an iron core composed of a bundle of soft iron wires about two and a half inches long and half an inch in diameter. The wires should be very small and plentiful. It is usual to use only one cell of Leclanche battery on the Blake transmitter and measurements given are on this basis. It is possible to

use more battery, but the coil must be in proportion to obtain the highest efficiency. The windings of the primary depends on the strength of the current and the resistance of the circuit. The reproduction of the vibrations will be greater as the resistance of the circuit is reduced; hence the reason for introducing the induction coil into the circuit which enables us to keep the total resistance of the originating, or primary, circuit very low and by increasing the number of turns in the secondary, the induced currents will have a very high E. M. F. and will be little affected by external resistance. The primary is usually wound to .5 ohms and the secondary to 175 ohms resistance.

The primary winding of the coil is usually two or three

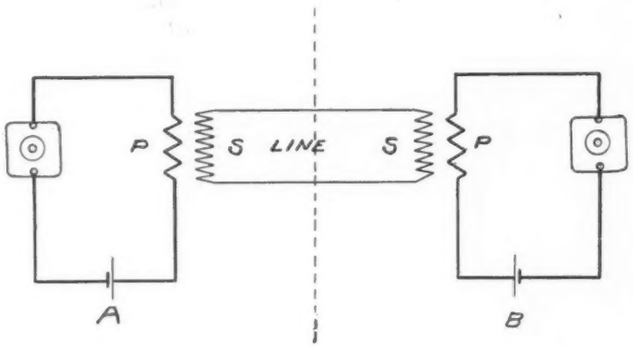


FIG. 4.

layers of insulated wire twenty mils in diameter, and has the insulation covering of a green color to distinguish it from the secondary, which is white. The secondary is wound over this, the number of turns being proportional, for while a large number of turns would make the reproduction louder, the clearness would suffer. The size of wire usually used in the primary is about twenty-four mils, two layers, and one hundred and eighty turns, the secondary six mils and 4,200 turns. In the induction coil there are two results obtained: (1) The electro-dynamic effect of coil upon coil (as explained in previous article); (2) the electro-magnetic effect, due to the iron core. In modern common-battery systems the induction coil is used in a different manner, and will be explained later. What has been said about the induction coil in the Blake style will also apply in the solid back, or granular carbon style, with the exception that the coil is nearly always larger. The primary for all styles is usually wound to one-tenth of the contact resistance and the secondary in direct proportion. The current necessary for the Blake transmitter is about thirteen amp. at one volt pressure. The adjustment of this style is made by short-circuiting the instrument at the line terminals, on top, by means of a short piece of wire, or other conductor, and blowing into the mouth-piece until the best sound is obtained, the reproduction of the vibrations in the primary coming up clear and distinct in the receiver, which is held to the ear of the adjuster. Sometimes a buzzing sound is observed, especially in new instruments, caused either by poor adjustment or too little pressure by the damping springs. A common trouble found is caused by pitting of the carbon button produced by vibrating against the platinum tip B, or ball, and may be removed by rubbing on fine crocus cloth, or, if too deep, the button should be replaced.

All contacts should be kept clean and inspected at each visit, as this is very essential to its good working, and if not watched carefully will produce a cut-out or intermittent fault, which is very aggravating to the user. These contacts must always be soldered.

Other faults frequently found are weak battery and bad adjustment. In adjusting, never touch the springs, as the only adjustment necessary, unless tampered with, is by means of the screw provided. Once in a great while trouble will be found in the induction coil, produced by lightning or other external causes.

Solid Back (Granular) Transmitter.—The first granular transmitter was invented by an English clergyman in 1878, and consisted of two small carbon discs arranged parallel to each other, the space intervening being filled with granulated carbon. The form now universally used is known as the solid back, and is, without doubt, the best. There is one drawback in its extended use for local service, and that is, where cables are used very extensively the induction is high and it is simply impossible to use them except where the cable wires are formed of twisted pairs and metallic circuits are in use. Its use has necessitated keeping the capacity of cables down to the lowest point. This form of transmitter is also superior to the Blake in that it is not susceptible to changes in temperature. The latest form of solid back is shown in Fig. 3. In this form the old objection to granular transmitters, such as the Hunning's, etc.,—namely, packing of the carbon, is overcome. The carbon holder is of brass and of two sections, the back solid and the front, which is fastened to the diaphragm, of a brass ring holding a thin mica cap. In the back is a carbon holder, as in Fig. 5, with indentations for the granules. The two parts are screwed together and are fastened to the frame by an adjustment holder. The diaphragm is insulated in somewhat the same manner as the Blake and the whole is inclosed in a moisture proof metal chamber. The vibrations of the diaphragm are transmitted directly to the carbon block, being fastened to it, and, as the mica ring is flexible and thin, does not interfere materially with this action. This transmitter, unlike the Blake, can be used in almost any position and is peculiar in that it is very susceptible to vibrations from the mouth-piece, but does not take up wall or other vibrations as readily as the Blake. The current necessary is about .32 ampere at three volts pressure. A hard rubber mouth-piece conducts the sound waves to the diaphragm. The chamber holding the granules is well sealed and their action can be seen through the mica disk. The resistance is usually about fifty ohms, but this varies a great deal according to whether local or common battery is used. In local battery work the induction coil is used, while in common battery it is customary to use the coil as retardation, leaving a choke coil effect. This could not be done with the Blake form.

It is to be observed that while in the Blake style the best results were obtained by talking about four inches from the mouth-piece; in the solid back one should talk right into it,

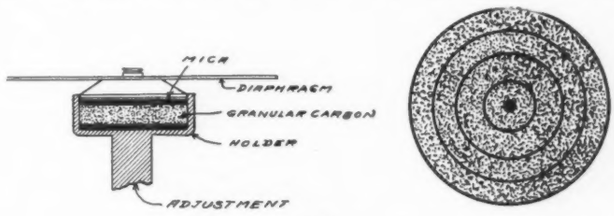


FIG. 5.

getting just as close to the mouth-piece as possible. The battery commonly used is two Fuller cells—too much battery will deteriorate the electrodes. The electrical resistance of the granules varies with the pressure, and when the pressure becomes too great, a partial or complete short-circuit takes place; when the pressure is not enough, a partial or complete disconnection or break in the circuit takes place. In both cases, such a condition renders the transmitter dead.

Carefully kept transmitters seldom need adjustment, and when necessary should be very carefully done, as it is easy to destroy the delicate electrodes or lose the granules. It is usually found best, when ordinary help is used and adjustment is necessary, to change the instrument and make the repairs in the workshop. When packing takes place it can

usually be removed by turning the transmitter down-side up and tapping it lightly on the side. If the packing occurs frequently change the carbon. If this has not the desired effect, return it to the maker as defective. Do not encourage subscribers to tap the transmitters on the side, as is done by many operators and inspectors, for this will very quickly destroy the adjustment. A short-circuit in a transmitter, if not due to adjustment, will be found to be caused by the two insulated parts becoming crossed either by a broken insulating brush, or the wire touching the frame. The resistance of the Blake transmitter is about five ohms; that of the solid back from twenty-five to seventy-five ohms, according to whether used for local or common battery work.

The transmitters used on switch-boards are nearly the same make, but the coil is usually larger and often composed of three windings instead of two, the tertiary, or third, being frequently used for the chief operator's monitor. These transmitters are adjustable so that operators can always talk directly into them. In many parts of Europe operators carry the transmitter on a breast-plate, made of aluminum, which has the advantage that the transmitter follows the operator when she is obliged to move to the right or left in making connections. It also enables her to have the free use of both hands, which is very important.

It will be observed in the construction of the granular transmitter that its success depends on the granules and it is very important that these be prepared with the greatest care. Ordinary graphite will not give good results as it is extremely susceptible to moisture and is very absorbent, causing, in time, short circuits, packing, etc. In order to overcome this hygroscopic tendency, the granules are usually filled with a special preparation which fills up the pores and renders them non-absorbent. The manufacturers are appreciating this fault and are now making the chamber as nearly moisture-proof as possible. One dealer guarantees to place his transmitter in water and it will retain its high efficiency. Absolute dryness of the working parts of all transmitters is essential to obtain and retain the highest efficiency. The amount of powder or granules usually used in one transmitter is about five grains.

Switch-board transmitters are generally used in conjunction with a closed circuit battery, which may be either gravity or storage, the latter preferred. The latter also enables a large number of transmitters to draw power from the same set of cells.

A frequent transmitter trouble is a frying noise and is usually due to too strong battery or loose connections. The strong battery forms numerous small ones between the carbon granules and the loose connections causes an intermittent break in the circuit. By increasing the number of granules the battery can be increased. This will also remedy noisy transmitters.

Universal Exposition Palace of Electricity.

The Palace of Electricity is located on the central avenue of the exposition grounds, and is one of the leading elements of the main exposition picture. The eastern exposure of the building faces the main lagoon, while the southern exposure fronts upon the grand basin and is in direct view of the electric fountains, the peristyle of the Festival Hall and the Art Building. On the east and north the building faces the lagoons, and is consequently entirely surrounded by water. No other exposition building is within 300 feet of its approaches.

The architects of this building are Walker and Kimball of Boston and Omaha, who were the chief architects of the Omaha exposition. They have given the design a bold columnated treatment of the Corinthian order. The columns are carried well down towards the ground, to give height to the facades. The facades are accentuated by elevated pediments and tower effects over the four main entrances and at the corners. Over the accentuated places, as well as over the twin columns, opportunity for ample sculptural decoration is supplied. The twin columns form a pleasing variation of the facades, and are so situated as to provide ample space for the placing of statuary between each pair.

The fenestration is bold and appropriate, giving ample and substantial wall treatment. On two sides of the building are loggias which add pleasing effects of light and shade. There are numerous openings in the facades such as exhibitors always seek in selecting their exhibit space. The plan of the building provides for an open central court which will be entirely surrounded by colonnades and made beautiful by masses of bowers. The court is expected to be a most pleasing feature, and to provide a quiet retreat and resting place for visitors from the thronged corridors and avenues.

The building is simple and well treated, and for it a scheme of indirect illumination is being worked out which will accentuate at night its beauty as seen by day. It offers exceptional opportunities for these effects of which advantage will be taken.

The design of the building is peculiarly well adapted for an effective display of exhibits, and is planned to make each of the 350,000 square feet of floor space available.

As at present outlined the scheme for the arrangement of exhibits provides for the placing of the lighter exhibits in the north corridors. The more massive exhibits will be given space in the east and west corridors, while the heavy machinery will be brought together in the south corridors. A tentative plan provides for the placing of the foreign exhibits in the east and southeast quarter of the building. This arrangement will mass the more impressive foreign and domestic exhibits at points admirably suited for a ready comparison without throwing the home products in direct contrast with those of participating nations.

In the east, north and west corridors, the exhibition space will be laid off in five long sections separated by wide central passages and less pretentious side passages, cross-connecting spaces being left opposite the side and corner entrances. It is not the present intention to prearrange passages in the southern end of the building where the heavy operating units, switchboards and controlling appliances will have space. These will be placed with the idea of rounding them into an imposing and effective display rather than of setting them relative to a predetermined system of platforms and passageways.

It is not so much the idea to fill the building with machinery and appliances on exhibition as to bring together within it such typical processes in the manufacture of electric machines and appliances as will represent in the highest sense a picture of the active life and vigor which the electrical industry now presents to the world, throughout the length and breadth of the United States. It was well said by Sylvanus Thompson, one of the greatest of the engineers visiting this country during the time of the Columbian exposition, that the electricity exhibit of America was not so much in what had been brought together at the exposition as in what was seen by the foreigners on every hand; in cities, towns, villages and highways. If this was true ten years ago, it is true to a far greater extent now than ever. Yet it is hoped that the exhibits in the Palace of Electricity will be in line with that evidence of the existence of a great vital force among us, which has made America famous, and that it will be not an exhibit of things built but of things building, an exhibit of progressive thought, action and evolution, rather than an exhibit of products,

which, being finished specimens of our handicraft, are typical not of the future, but of the past. It is hoped that the engineers of our world-renowned factories and operating companies will lend their energies to the perfection of a scheme whereby they can show to the visitors of the exposition at least one important process which has become characteristic of the electrical work over which they preside. With this the central feature of the exhibit fostered by them, ample opportunity will be afforded for grouping about it evidence of a more extensive participation in the electric industries than the working exhibit stands for. It is beyond question a fact that working exhibits are to the exhibitor worth vastly more than dead exhibits. The former attract the interest and hold the attention of the visitor. They draw spectators from the avenues, the lagoons and the colonnades to the buildings, and do much toward bringing

ELECTRICITY BUILDING, UNIVERSAL EXPOSITION, ST. LOUIS, 1904.

to a successful issue the purposes to which a universal exposition is primarily committed.

The space in the building will be free to exhibitors, and they will be granted free power for the operation of working exhibits, when it can be shown that their exhibits have been developed up to a point of perfection where they are really typical of the processes they purport to exemplify.

The heartiest co-operation will be extended to all exhibitors who have the success of their exhibits at heart, and who are working for the advancement, not only of the particular field in which they are engaged, but also for the prosperity of general and related electrical industries.

Electricians and the friends of electricity will not be disappointed in their hopes of seeing all that is new and important in the field of electricity. Negotiations are in progress looking toward a far more comprehensive showing of those features of electrical achievement which appeal strongly to the scientist and the layman alike than has ever been attempted. It is too early to speak with certainty of the plans of the Department in this respect, but no reasonable exercise of thought, energy or money will be withheld, to make the electrical displays of 1903 surpass those of other years.

EVOLUTION OF THE MESSAGE RATE.

The evolution of telephone service recalls to mind the improvement in the lighting of dwellings. First came the rush light, then the candle, oil lamps, gas and electricity. The old-fashioned methods were clumsy, troublesome, costly and a burden to the householder. Finally the gas meter made its appearance. The quantity of gas consumed was measured accurately and the consumer paid only for what he used. When the telephone was first introduced it was too high priced for only the rich to use. It was also a complicated piece of mechanism that required skill and patience in handling. It was a luxury, but it rapidly became a necessity. Then began the improvements, and they are still going on. Of great importance among these is the message rate system, which gives a cheap service to everybody. You pay for only such service as you need. It is optional with you whether you shall ring up your grocer or butcher for a few cents, or spend car fare and time in the weary work of delivering your own orders. It is as handy as your water supply. You turn the faucet and let the water flow, or you ring a bell and deliver your message. You are in touch with all places, practically, in your own city, and also with distant places should occasion require you to use long-distance calls. The advance in this direction is like the turning on of the gas instead of looking up the rush light. Progress, simplicity, efficiency are features of modern telephone service.

COMMON BATTERY TELEPHONE SYSTEM

A. W. TAYLOR.

By the term "common battery" is meant a system in which all the talking current, as well as the current for signaling the switchboard, is supplied from a battery placed at some central location. Such systems are also aptly termed central energy systems. The idea of using a common battery is not wholly new as it was attempted with more or less success a number of years ago. The trouble was, that where a number of lines were supplied from the same battery there was disagreeable cross talk produced, which created great dissatisfaction. Probably the first successful use of a common battery arrangement was in connecting the various transmitters on a switchboard to one battery.

Fig. 1 shows the method of connecting up the transmitters for this purpose. A, B and C represent three transmitters connected to a battery D. Very heavy bus bars are connected to the terminals of the battery and the wires from each transmitter are connected to these bars. To work this arrangement properly requires a battery of very low internal resistance or everything spoken on one circuit can be heard on the others. The only battery that can successfully be used is the storage battery, as the resistance is exceedingly small. Should transmitters A, B and C be connected in on one pair of lead wires as in Figures 2, there would be resistance introduced in the battery circuit which would cause a drop in the voltage of the circuit thus affecting the current in each of the other transmitters. The nearer the resistance of the battery circuit approaches to zero the nearer will the cross talk come to being absolutely eliminated. Of course it is impossible to get a battery resistance equal to zero and consequently there will be some cross talk theoretically; but it may be made so small that it cannot be distinguished by the human ear.

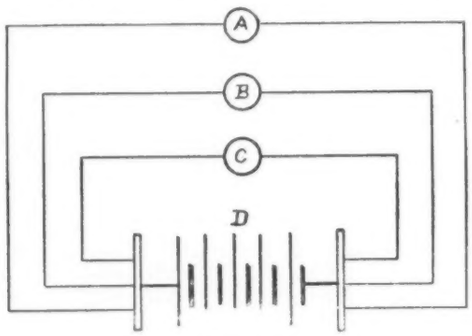


FIG. 1.

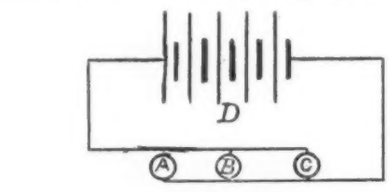


FIG. 2.

Now, if there is some cross talk due to battery resistance when the circuit is arranged as in Fig. 1, inserting impedance in each circuit will assist. Fig. 3 shows the circuit with the impedance coils G, H, I, K, L, M inserted in each circuit. These impedance coils consist of a coil of wire wound around an iron core. Such a coil has a retarding effect upon a sudden change in an electric current; this tends to prevent the increasing or decreasing of the flow of current in a line over which it flows. Suppose, for instance, that the flow of current through transmitter A causes a drop in the potential at the battery terminals. This will cause less current to flow through B. The impedance coils H and L, tend to prevent the sudden lowering in the current in this circuit. A reduction of current through A tends to increase the flow through B, but the impedance tends to prevent a sudden rise. Thus the changes in any one circuit due to changes in another are prevented by the retarding effect of these coils. The action of these coils is explained as follows. Whenever there is a change of magnetism in an iron core surrounded by a coil or solenoid an electromotive force is generated in the coil, the direction of which will be one way as the magnetic lines increase and in the opposite way when the lines of force are decreased in number. When a current passes through the coil from some external source the core becomes magnetized and an electro-motive force opposite in direction to the electro-motive force of the impressed current is generated because of the change in magnetism of the core. This then tends to prevent the rise of current in the coil. When the current, passing through the coil, is reduced the magnetism in the core is reduced which in turn induces a reversed electro-motive force in the coil and tends to continue the current in its same volume. It is upon this principle that all common battery or central energy systems depend to prevent cross talk.

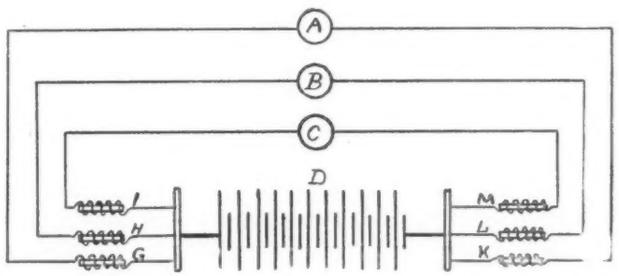


FIG. 3.

Figure 3 does not, however, show any way to converse with any other of the circuits on the other lines. It is rather to prevent intercommunication. Fig. 4 shows a system whereby this is accomplished and which theoretically is the same as the first working common battery system. A and C are impedance coils, B the battery and L L two lines between which conversation is to be carried. D and E are impedance coils of two other lines F F. Conversation between H and G may be conducted without being heard in any way by parties listening at instruments on lines F F, for the same reason that the two transmitters in figure 3 do not interfere with each other. In order to talk between G and H a high retarding force in the battery circuit is necessary. Should there be no coils A and C inserted in the

talking current would be all absorbed by the battery, as it would short circuit the two lines. With the coils, a very high impedance to an undulatory or alternating current is presented and thus conversation is possible without the short circuiting. The explanation of the transmission in figures is as follows and depend upon the theory of the flow of current in a divided circuit. Suppose the normal resistance of the line and telephone in each circuit is 100 ohms. Let each impedance coil be 100 ohms. The battery is 20 volts; the current flowing normally will divide so that half passes through each line, the total resistance of the circuit being 250 ohms. The total current is 20 divided by 250 or

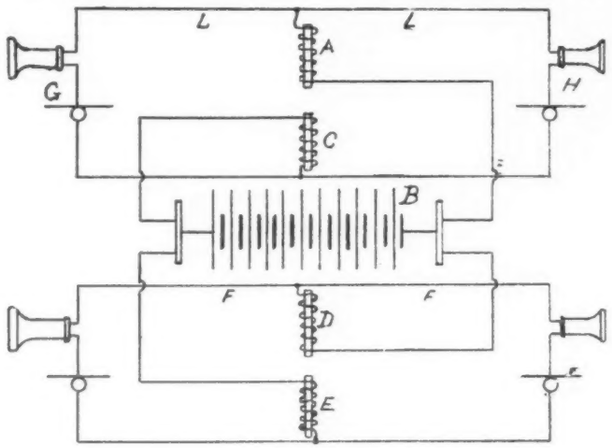


FIG. 4.

.08 ampere making .04 ampere for each line. Suppose now that the transmitter of telephone H decreases in resistance so as to give that line a resistance of but 50 ohms, then the current in both instruments would change, H taking more and G less. The total resistance of the circuit is 233 ohms. The current is .085, of which H takes 2-3 or .056 ampere, while G takes .28 amperes. Thus with every change in resistance in one instrument there is a corresponding change of current in both telephones.

This circuit never proved satisfactory on account of the

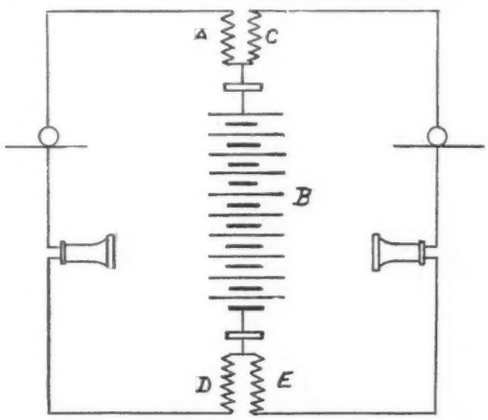


FIG. 5.

fact that unless both lines were of the same resistance there would be trouble in the distribution of the current. For instance if one of the lines of a connection happened to be very short and consequently of low resistance it robbed a long and high resistance line of its supply of current, making it difficult for the longer line to be properly heard. Some method therefore had to be devised whereby each line should be independent of the line to which it was connected, so far as its supply of current was concerned, and at the same time be able to transmit voice currents without loss. This was accomplished by using a repeating coil in each circuit, as is shown in figure 5. This repeating coil is wound so that the two halves are double; that is, the center of each half is cut brought out and used for battery connections; A D represents one half and C E represents the other half. B is the battery. Now, any change in the current in one telephone causes a change in the magnetism of the repeating coil core. This change then induces a current in the other half of the coil, which affects the telephone in that circuit. This is the principle of the central energy systems of nearly all of the Bell exchanges and it gives service on a par with that of the best local battery systems. Where the impedance coils are used it is customary to separate the two lines by means of a condenser after the manner of figure 6. A, C, D and E represent the impedance coils, F and G are the condensers. B is the battery. The condensers will allow an alternating or undulating current to pass, but prevents the passage of direct current. When the resistance of the circuit in which telephone H is placed, is increased, the potential across the points 1 and 2 of the coils A and B increase allowing the condensers to charge; as the condensers

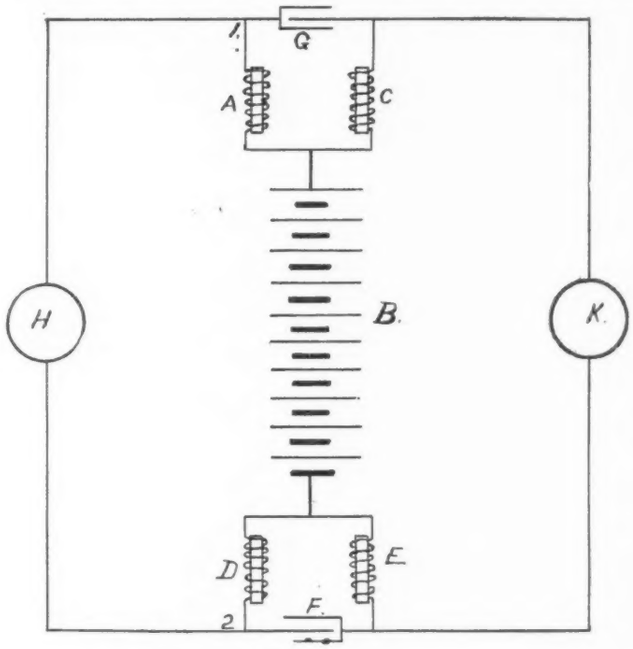


FIG. 6.

charge a current is drawn from the other line, which causes an impulse of current to pass through telephone K. Likewise when the current increases in H the condensers discharge owing to a reduction of the potential across the points 1 and 2.

These impedance coils may be placed in the cord circuits of the switchboards or they may be in the line circuit. In some cases part are in the line circuit and part are in the cord circuit. They are frequently made to act the part of the electro-magnetic apparatus, which controls the mechanical action of the switch board; such as relays for the line lamps and for the supervisory lamps.

It will be noticed that in the diagrams shown all the circuits have a coil between the battery and each side of the line. This is done to make an electrically balanced circuit. The circuits are operative with one side of the battery connected through the coil and the other to the line direct, but the combination is unbalanced. Where there are long lines thus unbalanced there is apt to be cross talk with adjacent lines running parallel. Also the lines will be noisy from near by lighting and power circuits. Should any such line be connected to a long toll line without the intervention of a repeating coil, the toll line will be so unbalanced as to

be almost unusable on account of the noise. With lines of moderate length such systems have given fair satisfaction. Such systems are largely used with lines having a common return wire.

In designing a central energy system all parts should be arranged in order to obtain a maximum amount of current over the line with a minimum voltage of battery and a minimum amount of short circuiting of the voice current through the coils and battery. If the impedance coils are wound too low there is considerable loss of transmission. What is necessary in this case is not so much the resistance, but a high number of turns of wire. The resistance, itself may be held down quite low especially so where the repeating coil is used. In this latter case the voice current passes right through the battery and the coils are frequently wound as low as seventy-five ohms on each half. It is necessary to have all the main battery leads on such systems extremely large, so as to keep down the resistance of the battery circuit, as there is greater danger of cross talk on this kind of circuit. In some of the larger Bell systems the main battery leads are of solid copper with a cross section of three square inches. Each repeating coil is individually wired to these heavy bus bars. In other exchanges of equal size, but using impedance coils the copper leads do not exceed that of a number 0000 wire.

The current should be as great as possible so as to provide sufficient current for transmitters on the longest lines, but at the same time not enough to injure the transmitter on the shortest line. It is good practice to provide for the long lines and let the short ones take care of themselves. The transmitter should be designed to stand the current.

The voltage of the battery should be great enough so that it will operate all signals over the longest lines. It is well to design the signals to be quite sensitive, so that an excessive voltage will not be necessary. A very high voltage is very apt to injure the transmitters, causing them to sizzle and fry. It is only an additional expense and not necessary in a well designed system.

All the coils should be wound to stand the entire voltage of the battery without danger of burning out. Where a system is balanced the coils used as impedances on each side of the battery; that is, those which furnish current to the line, should have exactly the same number of turns of the same sized wire wound on cores of the same size. This of course will produce a perfectly balanced circuit, but it is not absolutely necessary in every case and if the coils are within ten per cent of each other there will be no noticeable unbalancing except on a connection with extremely long toll lines. As the connection is always made through a repeating coil in these cases there will be no bad effect.

Another point which has been overlooked by many switchboard apparatus designers is the winding of the different coils with large enough wire. In many cases these windings have been of such fine wire that the protector systems for the exchange has not been able to act before the coil has been burned out.

THE LAMENT OF THE SMALL VILLAGE.

Telephones, rural mail routes, interurban and trolley lines have had the effect, it is said, of making small villages more quiet than formerly. A little crossroads settlement, with a general store, a postoffice, a blacksmith shop and a doctor's office as its chief business establishments is not at any time a very lively center, but the coming and going of the persons with affairs to transact at these places creates whatever stir there is and at times bring about the appearance of considerable activity. But now that the farm telephone has come into use its owner does not "hitch up" and go to the village as formerly to do his errands. He telephones to the storekeeper his order for goods and asks him to send them out by trolley or by the first man traveling that way; he consults the doctor over the telephone and talks with his friend in the village in the same way. The mail is brought to his gate, and thus relieves him of the necessity of a daily trip. His relations with the blacksmith remain unchanged, for no way has been yet devised whereby that useful personage can shoe a horse or mend a wagon without having horse and vehicle present. But these needs are not of daily occurrence, and so it happens that the little street or open square which was wont to seem almost crowded with horses and vehicles at certain hours every day or on certain days in the week now often wears a deserted look and the residents are conscious of a sense of loneliness. They say, too, that when once a man gets on a trolley car with intent to make a purchase he passes by the little country store and goes to a larger town, and that this is particularly true of his wife or daughter on similar errand. All this is a natural but rather curious development following the extended use of modern conveniences and what remedy the village has is not plain. Its only hope is apparently to establish attractions of a social or educational nature that will offset the loss in other directions and will draw its rural neighbors there for amusement and entertainment.

BLOOMFIELD'S BARBED WIRE SYSTEM.

The most unique telephone system ever installed, and the cheapest, too, is the one known as the barbed wire fence system in operation between Broomfield, Colo., and the headgates of the Ralston creek and the Rocky creek irrigation ditches up in the foothills beyond Golden. It is over twenty-five miles long and cost something like $10 to build. It has only two telephones, one at the headgate, the other at Broomfield, where there is a woman operator. Its reason for existence is that the man in charge of the headgate may be notified when to send down a head of water and how much. It takes a financial genius to build thirty miles of telephone system for nothing, and it could not have been done but for the existence of the miles and miles of barbed wire fence which extends along the section roads. All the financial genius had to do was to attach his telephone to a fence wire at Broomfield and follow that braid of wire to his objective point. Where there was a break in the wire another piece of wire and a pair of plyers soon did the business. Where there was a crossroad, or a railroad, or a gateway, the elevation or burial of the wire followed. The line is not as "straight as the crow flies," but it serves the purpose admirably. There was no pulling of wires for a franchise, for the farmers only too gladly consented to the use of their fences for the purpose.

One peculiar feature of this system is that only the opertor can begin the talk. When it is decided to send down water the operator calls up the man at the headgate and gives him specific instructions, which he must follow. If he has anything to say he must say it then or hold his peace till he is called up again, for it is not a circuit system and only the Broomfield office can call up.

This gives the lady the advantage of being able to shut off the other fellow at will and of getting in the last word. There is talk of borrowing another wire along the same fence and putting in a return circuit.

The telephone business has had a wonderful growth in Iowa during the past two years. In 1890 there were about 100 telephone companies doing business in the state. One year later there were 283 and at the beginning of the present year there were about 650, with a total mileage of wire of 22,409. The present year, despite the stormy weather, has been one of great extension of service.

The Future of the Telephone in the United Kingdom.

By J. E. Kingsbury.

To the members of the British Association the telephone and its applications can not fail to be of interest, for they must ever recall with pride that it was at the Glasgow meeting of the association in 1876 that Alexander Graham Bell's invention was first introduced into this country by Sir William Thomson of that time and the Lord Kelvin of this. The telephone then was a scientific marvel, and attention was centered on its improvement as a talking instrument. Some of its possibilities were foreshadowed, but its principal application was not foreseen. At the meeting of the association at Sheffield, in 1879, an exchange was shown in operation coincident with the opening in London of public telephone exchanges. From that time the science of the telephone has been the science of telephonic intercommunication.

Like all the more recent practical applications of scientific principles it is in itself a composite art calling to its aid not only acoustics and electricity, but of late years more particularly the heavier branches of mechanics and engineering, since the modern telephone exchange has anticipated the power schemes by producing at one center the electrical energy required to signal and to talk between thousands of stations over lines mostly placed underground at a considerable cost and requiring much engineering skill. Any one of the elements of this composite art would afford interesting subjects for discussion. But they have been and will be dealt with elsewhere and at other times, and will be only very casually touched upon in this paper. The future progress of the telephone in the United Kingdom does not depend upon scientific developments, but upon common sense. In this it does not differ from most engineering questions, for I take it that engineering is a means to an end—that an engineer would derive little satisfaction from the construction of a bridge, however beautiful its proportions, if the approaches rendered it of no utility.

There are at the present time some impediments on the approaches which need removal. They are of a political, economical and social nature, and they exist, as I think, largely on account of the peculiarities which differentiate a telephone exchange system from other works of practical utility. It is my object in this paper to attempt to remove some of the popular misunderstandings which undoubtedly exist, and by placing before you some of the features upon which telephone service depends draw some conclusions as to its future. You will, of course, be prepared for a considerable dip into the past and some reference to the present before the future is reached.

It is necessary to bear in mind that in 1870 various companies undertaking the transmission of telegrams were acquired by the state, and the work which they undertook was combined with that of the postoffice. The Act of 1869 extinguished competition in telegraphs, and conferred on the postmaster-general the exclusive privilege of transmitting telegrams. The postoffice had been carrying on this business for six years when the telephone was invented. Its development and application to purposes of profit in the United Kingdom took another three years, so that telephone exchange companies began operations in London in 1879. The postoffice claimed that the service rendered by the telephone companies was an infringement of the powers conferred on the state by the Telegraph Act of 1869. The telephone companies contested this claim, but it was decided in favor of the postoffice in the suit of the Attorney-General vs. the Edison Telephone Company of London (Ltd.), tried before Mr. Baron Pollock and Mr. Justice Stephen, in 1880.

The reasonableness of the decision is even now sometimes questioned, mainly because the act was passed in 1869 and the telephone invented only in 1876. But distinction needs to be drawn between (1) a service which the state reserved to itself the sole right of undertaking and (2) improvements in apparatus for, or in the means of carrying out, that service.

The service reserved by the state was the transmission of telegrams, and in Mr. Justice Stephen's very careful judgment he shows that within the definition of the Act of 1869, "any apparatus for transmitting messages by electric signals is a telegraph whether a wire is used or not, and that any apparatus of which a wire used for telegraphic communication is an essential part is a telegraph whether the communication is made by electricity or not." Thus the telephone was only an improvement in, or an accessory to, the service of which the state held a monopoly.

Counsel for the company gave notice of appeal, and the Attorney-General, on behalf of the Crown, stated "that, of course, the Postmaster-General is fully alive to the advantages derived by the public from telephonic communication, and whatever result this litigation may lead to care will be taken in the interests of the revenue, and also in the interest of the public, that nothing shall be done to stop telephonic communication so far as it is required by the public." This statement foreshadowed the policy which the government had considered it advisable to pursue, viz., to work the telephone exchanges through the medium of private organizations or public companies acting under license. Licenses were issued for a period of thirty-one years conditional on payment of ten per cent of the gross receipts. An indication of the government's intention to resume the working of the system at some period is given by a condition of the license that the government was to have the right to purchase the licensee's business at septennial periods upon giving six months' notice, and subject an arbitration in event of disagreement on price. The first licenses limited communication to four or five miles from a defined center, the state providing trunk lines between the areas. The limitation was found to be inconvenient. It was removed in 1884, and trunk wires between towns were erected by the companies. In 1896 the trunk wires were purchased by the postoffice, and the companies' work limited to "telephone areas" based on the requirements of localities.

Efforts have been made to obtain a reduction in the postoffice royalty which has been denounced at various times, and has been complained of as a tax on communication, as the newspaper stamp was denounced as a tax on knowledge. But even the sufferers by it did not universally condemn that objectionable tax, for Addison, in the *Spectator* of the day preceding the application of the stamp, intimated that he would glory in contributing his utmost to the public weal, and remarked that, "It is a received maxim that no honest man should enrich himself by methods that are prejudicial to the community in which he lives, and by the same rule I think we may pronounce the person to deserve well of his countrymen whose labors bring more into the public coffers than into his own pocket." In this mildly ironical way did Addison convey the information that of the price paid by the purchaser one-half went into the

*Paper read before Section G of the British Association at Belfast, September, 1902.

public coffers.. The telephone royalty is more moderate, and it can not be said that the labors of the telephone company put more into the treasury than is distributed among its shareholders, but the amount is a substantial one, for during the last ten years the company has paid in postoffice royalty £916,000 in round figures. For the past year the royalty was about £150,000. The royalty is a part of that protection of the revenues of the state to which the Attorney General referred, and so far as the companies are concerned it may be regarded as a payment by means of which they are enabled to earn dividends, since, without a license, it would not be possible for them to undertake the business at all.

The postoffice not only reserved the right to compete, but in some places actually did compete, and in others granted licenses freely to competing companies. The inference to be drawn from its attitude is that it was careful not to create monopoly outside itself, regarding freedom of action as tending to the public benefit, and was satisfied to let ordinary laws work out the solution of the problem so long as its sovereign rights were maintained and its tribute paid. The service was a new one; there had been no previous experience of its working, and no reasonable forecast could be made.

The competition which existed between the Bell company and the Edison company in 1879 ended by the amalgamation of the two into the United Telephone Company, in 1880, before any considerable work had been done, and resulted rather from the advantage of combining patent rights than extinguishing any extensive business competition. But, as a subscriber to the Edison company, I am able to bear witness to the advantage of the increased capacity of communication which resulted from the amalgamation, small as that would seem now. Shortly after the amalgamation a company called the London and Globe Telephone Company established an exchange in London, proposing to charge a reduced rental of £12 per annum instead of £20, the rate then ruling. The company discontinued its operations after a few hundred subscribers had been connected, because it was unable to obtain instruments free of the Edison patent. As a subscriber to the London and Globe Company, I can also speak from experience of the advantage of the reduction in telephone subscriptions which resulted from the cessation of a duplicate service. The other principal competitive exchanges during the patent era were at Dundee and Sheffield, and in anticipation of the expiry of the patents an exchange was started in Manchester by the Mutual company.

The Dundee company was purchased by the National Telephone Company at an early stage in its career; the Sheffield company was eventually absorbed, and the Mutual company lived but a comparatively short period.

The popular view of these amalgamations is well known. The real reason has been overlooked. Before formulating it, I will ask you to consider what a telephonic conversation is, and how it is obtained.

Let me make a comparison between telephone exchange service with which we have been familiar for a little more than twenty years and other services which have existed for much longer periods. There are no longer any competing telegraphs in England, but let us suppose there are. I desire to send a telegram to any town. I can take my choice of lines. There is no restriction whatever on the delivery of my message to any inhabitant of that town I may desire to communicate with. In the same way I may take advantage of railway competition by choosing the cheapest or quickest route, or I may prefer to take the longest or most expensive route on account of its natural beauties. What would be thought of the advantages of a railway competition from London to Liverpool if the latter city were divided into two portions, and it were ordained that for a destination on one side of St. George's Hall it would be necessary to travel by the North Western and for a destination on the other side by the Midland Railway. Let us suppose the issue of season tickets. With one season ticket a passenger would be able to reach one-half of Liverpool. If he desired to reach the other half as well he would require two season tickets, and would need to take a different route for either destination. By the division I do not mean a policeman outside the station to direct your cabman by a given street, which order he can evade at the next turning. You must please to imagine an impenetrable barrier. You regard this undoubtedly as a preposterous proposition, but it is exactly analogous to the conditions prevailing under competition in telephony. There are a restricted number of possible correspondents for distinct services or double season tickets if you wish to enlarge your area of communication to the fullest possible extent. The reason why competing services have ceased in the past, is because the absurdity of such a situation becomes obvious when put in practice.

Let us see how the subscribers of the lapsed companies fared in the combinations which have been made. The Dundee company, at the time of the amalgamation, had 332 subscribers; 152 of these subscribers belonged to both companies, and thus had two season tickets. Each subscriber to the local company paid £5 10s per annum. He thus paid 3.975 pence per annum each for the opportunity of communicating with 332 subscribers. On amalgamation the subscriptions of the 152 were slightly reduced and of the 180 largely increased, but the annual cost of the right to speak with each other subscriber was reduced from 3.975 pence to 2.919 pence, and with the increase in subscribers this reduction was continually growing in favor of the original subscribers. In addition to the larger number of possible correspondents in their own locality, the amalgamation gave the subscribers to the local company access to other localities, thus adding considerably to the value of the telephone to them. The influence of a widespread "telephone net"—to adopt a Continental expression—may be compared with the force of gravity. Sooner or later the smaller local body if it does not evaporate altogether must be attracted to the larger body. And if the repellant force natural to competitors should retard unduly the operation of this attractive force, then the latter will inevitably be assisted by some superior power in the interest of the public weal, for it must be remembered that the proprietors of exchanges and the subscribers thereto are not the only people concerned. The general public experience some of the drawbacks of this competition. As an example, I may cite an instance from Scandinavia—a part of the world frequently referred to in connection with the advantages of competition in telephony. About the time of the competitive services in Dundee, rival companies were giving the citizens of Christiana the same advantages, when (August 20, 1884) the "municipal council resolved, in accordance with the proposal of the executive committee, to notify the International Bell Telephone Company, and the Christiana Telephone Association, that after two weeks they shall not be allowed to run new telephone lines over the public streets, squares, etc., and the council appointed Messrs. Birch, Reichenwald, Anderson and Christopherson to aid the executive committee in negotiating with the telephone companies an amalgamation into a single company." The round-table conference succeeded in its efforts, the competition ceased, the number of subscribers grew rapidly, and the exchange has since been acquired by the government.

The experience of Dundee was not repeated in the United Kingdom for a number of years, because the National Telephone Company was protected by patent rights. On the expiry of the patents a number of public-spirited citizens of Manchester combined to remove from their town the stigma of being dependent on a telephonic monopoly, and to demonstrate to their predecessors of Dundee the iniquity of be-

ing bought up at a profit, they formed the Mutual Telephone Company of Manchester.

The Mutual company was in due course acquired by the National company. At the time of the amalgamation 492 of the 1,349 subscribers of the Mutual company also subscribed to the other company. The ration of subscription to number of subscribers—that is, the cost of the opportunity to communicate—was 1.320 pence per subscriber per annum. On amalgamation it was reduced to 0.567 penny.

In the parliamentary committee report of 1895 it is shown that the average payments of the Mutual subscribers were £7 8s 6d per annum. The average rate of the other company is not given. The normal rate was £10. The average would probably be slightly higher. The total payments by the people of Manchester before and after amalgamation were, approximately, as follows:

Before amalgamation—			
National	3,374 at	£10 0 0	£33,740
Mutual	1,349 at	7 8 6	10,016
	4,723		£43,756
After amalgamation—			
Combined subscribers	4,723		
Less duplicate	492		
	4,231 at	£10 0 0	£42,310

While the latter total is lower, yet in the absence of definite information as to the National company's average the figures must not be taken as more than an indication that, to the then existing subscribers, there was no very material change in the total cost of the service. But this, even if admitted, does not go far with the advocates of competition. The contention is that the lower rate was a paying rate, and that all subsequent subscribers have been overcharged by reason of the absence of competition.

The claim that the lower rate was a paying rate is based on the assertion that during the existence of the competing companies they were able to make both ends meet. I neither confirm nor combat the assertion, but I wish to correct an impression which is very natural to the mercantile mind. It is that on the fixed subscription plan every additional subscriber is a monetary gain. A new subscriber adds to the working expenses in that he not only makes calls himself, but increases the calls of other subscribers. With the growth of the exchange there is an increase of the apparatus or plant used in common, such as junction wires and switchboards, as well as in the number of operators. Hence, with the same class of equipment, the increase in subscribers leads to a disproportionate increase in cost of plant and working expenses.

The reason why the working costs at the present time are not considerably higher than in earlier years is because the class of equipment is not the same. Improved appliances have been introduced, additional plant has been erected or old plant reorganized, enabling the work to be done more economically. But these improvements have cost money, and it will at once be seen that upon these early exchanges, which are so often referred to, further expenditure would need to have been made without an increase in revenue, and from this may be seen the importance of making an allowance for depreciation before arriving at the cost of the service. Depreciation in telephone plant must not be confounded simply with the wear and tear of ordinary machinery. Certain portions may be claimed to be practically indestructible in themselves and yet require considerable depreciation allowance. This arises from the changes caused by growth whereby plant is displaced, even though capable of continued use. No rule can be laid down for universal application. There are instances of five per cent and of fifteen per cent being allowed, but the medium figure is more general.

As I have said, the real lesson of the amalgamation was never learned. The apparently profitable nature of telephone enterprise, the invariable maintenance of the rates at the higher level conveyed an impression which has been sedulously fostered that the absorbing telephone companies were simply seeking, in Addison's words, "to enrich themselves by methods that were prejudicial to the community," and parliament determined by the act of 1899 to develop, by the aid of the ratepayers, that competition which had so far failed under private enterprise. Two municipalities, Glasgow and Tunbridge Wells, have taken advantage of the permission and history is repeating itself in its usual way.

The first annual report of the telephone committee of the Glasgow corporation shows that £192,693 14s. 3d. has been spent in equipping an exchange for 5,494 stations. "The stations are subscribed for by 4,697 persons and firms; of these 2,059 have never been telephone subscribers before." This may be taken to mean that all the other subscribers to the municipal exchange are also subscribers to the company's exchange. The average capital expenditure per person or firm (not per station) is £41, but the total expenditure includes work which is very properly undertaken in advance of requirements, and it is a reasonable inference that with a comparatively small additional expenditure sufficient subscribers could be added to reduce materially the above average. It is futile to take only the cost of the usable lines, because there always will be considerable excess. I want only to make a comparison between the useful and the useless expenditure. At a capital outlay of £35 each, 2,059 new subscribers give a useful expenditure of £72,065, and 2,638 a useless expenditure of £92,330. It is not necessary for me to suggest how very much more useful that useful expenditure would have been if it had widened the field of the new subscribers.

In Tunbridge Wells the same results of duplicate subscribers and duplicate subscriptions are found, as was inevitable.

The necessity of anticipating demand and the supply of plant largely in excess of that actually used is inherent in telephone service. Conduits in anticipation of cables, cable in anticipation of subscribers, switchboard equipment in excess of immediate requirements—all these necessarily exist in any well-planned exchange.

Every subscriber must bear his proportion of the excess, since, of the revenue obtained from the subscribers, a portion must be devoted to interest on capital. Duplicate the system and, if they are equally well planned, you double the surplus plant, the capital expenditure therefor and the subscribers' burden thereon.

Compare the action of these municipalities with the admirable arrangement concluded by the postmaster general in London, where every subscriber to the postoffice system is in communication with all the 40,000 subscribers to the previously existing system, so that duplicates are unnecessary and no expenditure is wasted. Competition is a check—a means of preventing undue profit being made by the producer of a commodity or the supplier of a service, and the maintenance of the check requires the continuance of the competition. Technical advocates of competitive telephony realize its temporary character, as will be seen from the published report of the Glasgow engineer recommending another English municipality to undertake competitive service. Dealing with the question of intercommunication between the rival exchanges, he says: "Intercommunication locally from the beginning would render the development of the corporation exchange difficult. . . . But when the corporation's exchange has become larger the conditions will be reversed. . . . On reaching that point, intercommunication might be insisted upon by the corporation with every advantage, for the effect would be to complete the ruin of the opposition system."

It might be argued that it is not the province of a municipality "to complete the ruin" of an enterprise rendering a useful service to any of its ratepayers. It might be suggested that the attempt to destroy sometimes results in being destroyed, but I prefer rather to approach the consideration of municipal telephones in a spirit of sympathy with the municipal ideal and a realization of the advantages which may sometimes be obtained by collective effort. It is not surprising that, in the absence of an accurate conception of the nature of telephone exchange work, a municipality should be regarded as a suitable body to undertake it. The first idea that occurs to one is that the municipality is the local authority, and yet, as applied to a telephone area, a municipality is only one of several authorities, for, while the business centers throughout the kingdom have grown, the municipalities remain to a very large extent simply extensions of the old parochial system, and the extensions have not been carried far enough. The telephone area is the whole district over which the business and social relations to the locality naturally flow, but in its flow it covers numerous ownerships. There is no rivalry equal to the rivalry of neighboring municipalities; there is not a common interest, and in the absence of identical interests there is difficulty in obtaining agreement in policy or on the details of carrying out of a policy.

Agreement may sometimes be obtained as the result of an enthusiasm against what is regarded, rightly or wrongly, as a common foe; it may be continued while the contest lasts. Assume that the ruin of the opposition is completed, will the cohesion continue? Localities change their condition. The fashionable quarter to-day is the business quarter to-morrow. It is the interest of the outlying district to develop its resources. It is the interest of the older and larger municipality—the predominant partner in the telephone area—to retain its prestige, to prevent the development of its rivals. The telephone will be an important factor in such rivalries. Unless it be in Independent hands it is easy to foresee a splitting up into smaller units, adding to the confusion, increasing the cost and generally working to the detriment of the service.

The successful supply of electric light, for example, by municipalities must not be regarded as any criterion of a similar result in the case of telephone exchanges. An electric light station contains a producing plant, the streets carry distributing mains, the service is from the center outward and the entire plant from center to extremities is under one control. A policy may be initiated and enforced without regard to outside considerations. Telephone exchange service, on the other hand, requires that the system should work in with other systems.

Traffic between two places calls for provision for outgoing calls at one exchange and provision for incoming calls at another exchange. Independent views at either exchange are incompatible with successful working. Neighboring municipalities running tramway services might so arrange that there could be no through communication, but the inconvenience occasioned to the passenger would be only that of stepping out of one car into another. The equivalent in telephone service would be the stoppage of communication altogether.

One of the arguments urged for local control is that a large percentage of conversations are local. But compare the value of a local conversation with a long-distance conversation and it will be seen how important it is that no impediment, either of an engineering or administrative nature, should be placed in the way of such communications. Experience shows an almost inevitable tendency to local or individual preferences, both in the way of engineering and management, and experience shows also not only the practical difficulties arising from such preferences, but also the greater difficulty of applying a remedy.

It is sometimes assumed that competition is necessary in order to increase the number of subscribers. I will give an example of phenomenal increase without competition. On January 1, 1894, there were about 10,000 stations in New York. On January 1, 1902, there were 72,189 stations in only a portion of the area which was included in the 1894 figures. This considerable increase over the previous progress is attributed to the adoption of a rational system of charging. Up to 1894 there was a "flat rate," the same subscription for large user and small user. In 1894 the message-rate system was applied, with the result that the telephone service has become available to the small user and enormously increased in value to all subscribers by widening the field of communication. This method has also been adopted for the postoffice system in London. It was proposed for adoption some years ago by the National company in Sheffield, but the subscribers rebelled against it.

I have remarked on the extent to which the future has to be anticipated by present expenditure. Each new subscriber involves capital outlay, and new present work invariably includes some margin for future use.

The amount expended during the past five years in adding to the exchange construction and equipment of existing services by similar organizations in the United Kingdom and the United States compare as follows:

	National Telephone Company.	Licenses of American Bell Telephone Company.
1897	£460,937	£ 973,063
1898	682,506	1,489,499
1899	742,151	3,189,892
1900	834,772	4,382,908
1901	536,793	4,400,000
	£3,257,159	£14,435,362

In making these comparisons I wish rather to draw attention to the yearly growth than to compare totals. In the United States there is considerable growth in new expenditure from year to year. In the United ingdom there is a fairly gradual increase to 1900, and a decrease for 1901. The difference suggests some reason.

I think it will be found in the fact that in the United States the companies supplying the service have no limit to their existence. In the United Kingdom the company supplying the service dies in 1911, or, to put it more accurately, its right to continue business dies then. To the parliamentary committee of 1898 Mr. Forbes stated that it would be the policy of the company not to embark on new expenditure after 1904, but to maintain its existing system in the best condition till the expiry of the license in 1911. By the telegraph act of 1899 it is provided that the license of the National company shall be extended in those areas in which competitive services are stated, the restrictive barrier against intercommunication being gradually broken down. With longer life the hesitation to undertake further expenditure disappears, for the longer period in which returns may be obtained warrants new investment by the company.

Corporations can borrow easily and cheaply. We thus have financially a most anomalous situation. Money can be spent on competitive systems, which are the most wasteful, which give the maximum of inconvenience with the minimum of public benefit, but money cannot be spent on developing the existing systems to which additions can be made at a minimum cost with a maximum of benefit. The future of the telephone depends very much on the present, for equipment for present subscribers includes some provision for future subscribers, and present starvation means future weakness.

The engineering and construction work should be on a scale that provides for considerable growth, and of a kind that will give reasonable expectation of satisfactory results

when that growth is attained. On sound financial principles work on such a scale cannot be undertaken on the terms of existing licenses. The best that could be expected with a sole tenant is a reasonable surplus on present requirements. The best that can be expected from competitive services with unremunerative rates and short tenure is hand-to-mouth construction work and speedy dilapidations.

The existence of duplicate services designed and operated without regard to one another necessarily means that on the expiry of the licenses it may be found better and cheaper for the state to lay down a new system than to attempt to combine the existing ones. I regard it, however, as extremely doubtful that competitive systems will continue to the end of the license. It seems to me that the result of the competitions now in progress may be easily foretold. I venture the suggestion that competition by municipalities was provided for under a misapprehension of the nature of telephone exchange service, and a misconception of the results, direct or indirect, which might be expected. I venture further the suggestion that those municipalities which have undertaken such competition have done so under a mistaken view of the benefits to be obtained and the cost of obtaining them. But I have too great a faith in public opinion to doubt that as the lessons are brought home the result of existing competition will be the same as previous competitions. Duality will give way to unity as the only reasonable method of conducting the work. Unfortunately, the disadvantages must be apparent and realized before they are regarded, and probably much expenditure will be incurred before the mistake is recognized. In the meantime the future progress in the practical use of the most beautiful and most useful application of science which the past century produced will be seriously impeded.

The "removal of any disadvantages of a public kind which impede the progress of science" is one of the objects of the British Association. The impediment is so much of a public kind as to be fraught with peculiar difficulties and to involve important considerations of imperial and local politics which are out of our province. I can only hope that the subject may be considered solely from the point of view of the "public weal," and that scientific inquiry may have some share in reaching conclusions. If that be the case I do not hesitate to express my own belief that the future of the telephone in the United Kingdom will be free from competition, free from the expense and waste of war, developed by the certainty of permanent utility and cheapened by the economy which unity of control and permanent work will attain.

KENTUCKY AND INDIANA TELEPHONE CONVENTION.

Considerably over a hundred delegates, representing twenty-eight telephone companies in Kentucky and about half that number of Indiana corporations, assembled at Exchange Hall, Board of Trade Building, on the morning of Tuesday, October 28, for the opening session of the Kentucky and Indiana Independent Telephone Association. The joint session was the fourth assembly of the Kentucky Independent Telephone Association and the third of the Southern Indiana Independent Telephone Association. The meeting was called to order by Mr. R. V. Bishop of Cynthiana, Ky., the president of the Kentucky association. With him on the platform was Mr. G. A. Keinle of Huntingburg, Ind., president of the Indiana association.

The address of welcome was delivered by City Attorney Henry L. Stone, representing Mayor Grainger, who was absent from the city. Mr. Stone tendered a hearty welcome to the delegates to make the best of the city's possibilities, and welcomed the increasing power of the Independent movement.

Colonel W. C. P. Breckinridge of Lexington, Ky., was to have responded on behalf of the Kentucky association, but was detained by legal business. The response was therefore delivered by Mr. H. K. Cole, vice-president of the Kentucky association.

Mr. G. A. Keinle responded on behalf of the Indiana delegates. He stated that the Indiana delegates were at first in favor of having the joint convention at Evansville, Ind., but they had been unable to resist the allurements held out by their hosts of Louisville. Kentucky and Indiana, he said, were more than sister states, especially in the matter of better and cheaper telephone service. He exhorted the members present to promulgate their best ideas to the betterment of the Independent telephone movement in general.

The first paper of the afternoon was read by Mr. S. P. Sheerin of Indianapolis, who has for some time taken a prominent part in the work done by the litigation committee of the national association of Independent Telephone companies. Mr. Sheerin gave a comprehensive report of the contest which has been going on between the older company and the independent organizations with regard to the various patents involved. He called attention to the fact that the members of this committee had conducted their labors without pay, and that they are already personally liable for about $12,000 in costs, etc. In order to meet this and to raise a further sum of $12,000, it has been decided to assess each state association. Kentucky's share, he stated, will be $1,000 and Indiana's $2,000. On motion, Mr. Bishop, D. L. Prewitt, J. L. Brailey and John A. Armstrong were appointed a committee to plan the assessments and report at the Wednesday business session.

Mr. D. L. Pendleton of Winchester, Ky., read a paper on "Rates," presenting some very strong arguments for the adoption of uniform rates by the Independent companies as soon as possible. The discussion of this paper was referred to the business session of Wednesday.

Mr. H. K. Cole read a paper entitled "Long-Distance Toll Lines and Connections." This paper was supplemented by a report from Mr. J. L. Brailey, who has charge of the Independent long-distance system being constructed out of Louisville. Mr. Brailey reported that long-distance connections with Lexington, Frankfort and the entire Bluegrass region would be in operation by Sunday, November 2. The long-distance lines to Elizabethtown and the southern part of the state are already in operation. The lines to Owensboro, Henderson and Weston would be in operation within ten days' time. The report was received with great applause by the delegates.

Mr. E. M. Coleman, secretary of the Louisville Home Telephone Company, and secretary also of the Interstate Telephone Association, made a report as to the progress of the big association which was organized in Chicago last April.

Mr. A. J. Payton, Rockport, Ind., was to have read a paper on "The Bell People as Antagonists," but was prevented from being present. The paper entitled "Franchises," by Colonel John R. Allen of Lexington, was also left unread, the author not being present. At the conclusion of Mr. Coleman's paper it was announced that a smoker would be held at the Louisville Hotel on Tuesday evening. An invitation was also extended to the delegates to attend a banquet to be given Wednesday evening at Fountain Ferry Park by James S. Clark, Jr., the Louisville electrical manufacturer, special cars to the park being supplied by the company.

The smoker in the evening was a most enjoyable affair. In addition to the delegates a number of Louisville, New Albany and Jeffersonville business men were present as invited guests. When the guests had assembled Mr. R. V. Bishop announced that every man called upon would be obliged to respond with a story. A number of good anecdotes were thus brought out and among the speakers were

President Bishop, President Keinle, Mr. Desha Breckenridge of Lexington, Mr. David Bush of Winchester, Mr. R. E. Ashbrook of Paducah and Mr. Jacob Zinsmeister of New Albany.

The second and closing day of the convention was a busy one for both associations. While the papers were read to joint sessions, the executive business was conducted at special meetings held by the associations on Wednesday afternoon at the Louisville Home Telephone Company's building. The joint assembly Wednesday morning was opened by the reading of a paper by Mr. A. L. Tetu, of Louisville, on "Operating and Governing Telephone Plants." This paper was a review of the practical problems of exchange management.

An interesting address, dealing with the future of the Independent telephone movement, was delivered by Mr. J. L. Brailey, of Toledo, Ohio. The title of Mr. Brailey's paper was "Merging of Independent Telephone Plants." He called attention to the fact that the companies are dependent on each other, and stated that the establishment of long-distance connections is hastening the time when all the companies will become parts of state and national organizations.

Each of the associations then went into executive session for the election of officers. Mr. John A. Armstrong was nominated for president of the Kentucky association, but declined. Mr. D. L. Pendleton, of Winchester, was then nominated and unanimously elected. All the other officers of the association were re-elected, as follows: Mr. H. K. Cole, Lancaster, vice-president; James Maret, Mount Vernon, Ky., secretary and treasurer.

The Indiana association re-elected all the old officers.

DECISION ON AN ORAL LICENSE.

In the Circuit Court of the United States, for the District of Indiana. Frank B. Cook vs. The Sterling Electric Company et al. Chancery, No. 10084. Baker, District Judge.

On April 19, 1902, Frank B. Cook, complainant herein, filed his bill against the Sterling Electric Company et al., in which he alleges that he was the first and original inventor of a certain new and useful improvement in telephone switch boards, and that on January 16, 1900, letters patent No. 641,373 were duly granted to him therefor. He further alleges that the defendants unlawfully and without his license have made, used and sold sundry specimens of the apparatus covered by his patent, and are threatening to continue so to do, to his great wrong and injury; and he asks for an injunction restraining the defendants from making, using or selling the invention covered by his patent, and for damages. The application for the patent was filed in the Patent Office on February 8, 1898.

The defendants have filed a plea to the whole bill which, omitting the caption and formal parts, is as follows:

"That prior to any of the acts complained of in said bill the complainant herein on or about the 3d day of October, 1899, and prior to the issuance of said patent, made with the Sterling Electric Company, defendant herein, an oral agreement purporting to grant thereby to said Sterling Electric Company, and to its officers and directors in its behalf, the exclusive right to make, use and sell, and to license others to make, use and sell various improvements, among which was the improvement in telephone switchboards described in United States Letters Patent No. 641,373 for the full term of the life of the said patent throughout the United States, in consideration of four hundred shares of the capital stock of said Sterling Electric Company of the value of $40,000, and $8,000 in cash, which was paid to said complainant.

"That since the making of said oral agreement said complainant, Frank B. Cook, has repeatedly stated orally and in writing to these defendants and to others that the corporation defendant and the individual defendants, who are officers and directors of said corporation, in its behalf have been authorized and exclusively licensed to make, use and sell and to license others to make, use and sell the apparatus described and claimed in said letters patent throughout the United States by him, the said Frank B. Cook, the patentee of said patent, during the entire life of said patent—all of which statements these defendants aver to be true, and they plead said license to the said complainant's bill and pray judgment."

The plea has been set down for argument by the complainant, who insists that the same does not state facts sufficient to constitute a bar or defense to his bill. The various contentions of the complainant are reducible to the single proposition that the oral agreement of sale set up in the plea is void at law, and that being void at law it must be regarded as void in equity; or, stated in other words, that an oral agreement for the sale of an invention made after application for a patent and before it is granted, is invalid, both at law and in equity, when pleaded as a bar or defense to a bill by the patentee for infringement.

The court entertains no doubt that an oral agreement for the sale of an invention, founded on a sufficient consideration, made pending an application for a patent, is valid in equity and constitutes a good defense to a suit brought by such inventor after he has obtained a patent for the invention. The inventor of a new and useful improvement acquires thereby no exclusive right to it until he obtains a patent. The exclusive right is created by the patent, and no suit can be maintained by the inventor against any one for using it before the patent is obtained. But the inventor of a new and useful improvement is vested by law with an inchoate right to its exclusive use which he may perfect and make absolute by proceeding in the manner which the law requires. Cook possessed this inchoate right at the time the oral agreement of sale was made. The invention had then been made and an application was pending to obtain a patent.

This inchoate right to the exclusive use of the invention was a property right and the subject of bargain and sale unless forbidden by the statute. The statute (Section 4898 R. S. U. S.) does not prohibit such bargain and sale. It applies solely to the assignment, conveyance or grant of a patent or an interest therein, and not to the sale of the invention before the issuance of a patent. The statute does not profess to deal with the invention until the inchoate right to its exclusive use has been perfected and made absolute by the obtaining of a patent. Before the patent is granted the sale of the inchoate right to the exclusive use of an invention is governed by the general principles of the law relating to bargains and sales.

The case of Gayler V. Wilder, 51 U. S. 477 decides that the inchoate right to an invention may be sold and assigned before a patent therefor has been granted. In that case, it is true, the assignment was in writing, but unless a right of property existed in the invention before the patent was issued, the assignment would have been invalid for want of a subject-matter on which it could operate. In this country where the principle of the patent laws is recognized, where an invention is regarded as property which may be set apart for a person's own exclusive use, why is it not assignable without an enabling statute? What reason can be assigned why an invention, which is regarded as property, shall not be transferrable like other property, there being nothing in the statute to prohibit it? In my opinion it can be done. An oral assignment or sale of an invention before the issuance of a patent therefor, is valid, and invests the purchaser with the equitable title, and the inventor who, after such assignment or sale, obtains a patent, holds the legal title in trust for the owner of the equitable title. Pitts vs. Whitman, 2 Story, 609, id. Fed. Cas. No. 11,196; Whiting vs. Graves, 3 Ban. & Ard. 222, id. Fed. Cas. 17577; Hapgood vs. Rosenstock, 23 Fed. 86; Continental Wind Mill Co. vs. Empire Wind Mill Co. 8 Blatchf. 295, id. Fed. Cas. Bo.

3142; Dalzell vs. Deuber Watch Co. 149 U. S. 315; Somerby vs. Buntin, 118 Mass. 279; Burr vs. De La Vergne, 102 N. Y. 415, id. 7 N. E. 366; Whitnew vs. Burr, 115 Ill. 289, id. 3 N. E. 434; Burke vs. Partridge, 58 N. H. 349; Springfield vs. Drake, 58 N. H. 19; Blakeney vs. Goods, 30 Ohio St. 350; Searle vs. Hill, 73 Iowa 367, id. 35 N. W. 490.

These cases establish the doctrine that an oral agreement for the sale and assignment of the inchoate right to the exclusive use of an invention before a patent has been granted therefor, is not within the statute of frauds, nor within Section 4898 of the Revised Statutes, requiring the assignment of a patent or of an interest therein to be in writing; and that such an agreement may be specifically enforced in equity upon sufficient proof thereof.

It is claimed that whatever may be the equitable rights of the defendants under the agreement, the legal title is in the complainant and that the oral agreement can not be set up as a defense, and that the defendants should file a bill setting up their equitable rights and compel a transfer of the legal title.

It suffices to say that this contention overlooks the fact that this is a suit in a court of equity where, in matters within its jurisdiction, an equitable title is as good as a legal title as to all parties affected by such equity. It can not be maintained in a court of equity that a party holding the equitable title will be denied his equitable rights by the holder of the naked legal title. In such a case the holder of the legal title stands, in a court of equity, as a mere trustee for the use and benefit of the owner of the equitable title or estate. It certainly would be against conscience to permit a complainant, while holding the consideration for the oral agreement of sale, to pursue the defendants as wrong-doers.

No objection either in point of form or substance has been pointed out to the plea by any exception thereto. When a plea is set down for argument without any replication, no objection can be taken to its form or regularity. Such objection can only be made by exceptions. By setting the plea down for argument the complainant tests its legal sufficiency and in effect demurs to it. The truth of all facts stated in the plea which are well pleaded are admitted, however inconsistent with or contradictory of the allegations of the bill. 2 Beach Mod. eq. Pr. sec. 325.

The plea is allowed as sufficient with leave to the complainant to reply thereto, if so advised, within twenty days; failing to reply, the bill will be dismissed.

ANOTHER CASE FOR THE TROUBLE MAN.

Mrs. Hawkins is 68 years old. Her hair is white. She wears black alpaca dresses, black elastic gaiters and weighs 200 pounds. She is a substantial pillar of a Congregational church on the north side.

She was passing through the hall of her home when the telephone bell rang. She took down the receiver.

"Hello!" said a youthful and confident masculine voice. "Is this Mrs. H.?"

Not one, even of Mrs. Hawkins' most intimate friends, has ever dared to address her as Mrs. H.

"Sir?" she answered, indignantly.

"Is this Mrs. H.?" he repeated.

"What do you mean, sir?"

"Well, you needn't get sore about it, Maggie."

By an incredible coincidence Mrs. Hawkins' first name is Margaret.

"I just wanted to know where I could meet you to-night, that's all," he went on.

"Whom do you think you're talking to, sir?" demanded the indignant old lady.

"Oh, you can't fool me, old girl. I know your voice."

"What number do you think you're talking to, sir?"

"Isn't this six double naught thirteen, northwest?"

"This is double six naught thirteen, sir, Mrs. Hiram Hawkins' residence. And I'd advise——"

But the man at the other end had already hung up the telephone and fled.

A TELEPHONE EPISODE THAT NEARLY CAUSED A SCANDAL.

A woman will carry on a little heart-to-heart talk over a public telephone for all the world as though nobody on earth could hear her except the man—of course, it is always a man—at the other end of the wire. She will scream sweet nothings into the receiver with all the blushes and dropping of the eyes and dainty dimplings which a face-to-face conversation would require and with a calm unconsciousness of the entertainment she is affording the half-dozen people waiting to get at the telephone. It was not sweet nothings, however, that a smart-looking girl with a retrousse nose uttered in a New York hotel office recently, nearly giving the clerk a spasm and almost causing her own arrest.

She wore a coral chain and a picture hat and she looked so fresh and innocent that when she walked in and asked the telephone girl for a down-town number two men who were standing at the desk stared at her with that how-I'd-like-to-take-you-out-to-lunch glance that men always give an exceptionally pretty girl. The half dozen bellboys stared, too. And this is what they heard:

"Hello!"

"Yes, it's Polly. How did you know?"

"I just wanted to make sure that you got him."

"Did you leave him dead or dying?"

"Stabbed through the heart? Why, Jack, that's jolly! You can just wallow in his gore!"

The eyes of the bellboys bulged and bulged. One of the men at the desk grew excited. The hotel clerk looked darkly suspicious; but the young woman continued with a smile of perfect serenity.

"Left a young wife? You ought to be able to get something out of her. How much do you think you'll be able to get out of the whole business? If you get enough will you take me to supper on the proceeds?"

"Keep it dark? Of course I will. No, I can't help you out to-night. But you'd better take an early train in the morning. I'll be at the station to meet you."

And then, just as the bellboys were all standing on tiptoe and the clerk was about to call a policeman and the two men at the desk were eyeing her with unconcealed disgust, she added:

"Jack, dear, you're a wonder. There isn't another reporter in the city who can write a good murder story. Do try to make it two columns and we'll have that supper."

And she hung up the receiver and walked out pink and smiling, all unconscious that she had nearly caused one of the biggest hotel scandals in recent years.

TOOK IT FOR A SLOT MACHINE.

An elderly woman entered a drug store in Argentine recently and asked if the druggist had a telephone. The latter pointed to his telephone, one of the kind in which a nickel must be dropped before a connection can be secured.

"Is that all the telephone you have?" asked the woman.

"Yes," replied the druggist.

"Well, I have lived fifty years," replied the woman, "and never gambled and I don't intend to begin by playing them slot machines now."

Telephony.

AN ILLUSTRATED MONTHLY TELEPHONE JOURNAL

Published by

The TELEPHONY PUBLISHING CO.

H. B. McMEAL, President.

MANHATTAN BUILDING, CHICAGO, ILL.

Telephone Harrison 2951.

ED J. MOCK, Business Manager.

C. A. KENWORTHY, Advertising Manager.

OFFICES:

NEW YORK, 120 W. 30th St.

LONDON, 2 Exeter St., Strand, London, W. C.

SUBSCRIPTIONS:

In the United States, Canada and Mexico : : : $1.00 Per Year

Foreign Countries, $2.00

ENTERED AT THE CHICAGO POST OFFICE AS SECOND CLASS MAIL MATTER

CHICAGO, DECEMBER, 1902.

Table of Contents.

Interstate Independent Telephone Convention.....231-232
Officers Interstate Independent Telephone Association..... 233
Finance Committee Interstate Independent Telephone Convention 234
Entertainment Committee Interstate Independent Telephone Convention 235
Digest of Telephone Patents—Edward E. Clement.....236-243
Insulating Material—Waxes—H. M. Deavitt.....244-245
Telephone Situation in the Twin Cities—H. L. Howard....246-255
Profit in Answering Promptly..... 255
Practical Telephony—P. Kerr Higgins.....256-258
Universal Exposition Palace of Electricity.....258-259
Evolution of the Message Rate..... 259
Common Battery Telephone System—W. A. Taylor.....260-262
Bloomfield's Barbed Wire System..... 262
The Future of the Telephone in the United Kingdom—J. E. Kingsbury 263-267
Kentucky and Indiana Telephone Convention.....267-268
Decision on an Oral License.....268-269
Another Case for the Trouble Man..... 269
A Telephone Episode 269
EDITORIAL—
Interstate Independent Telephone Association.....270-271
The Opportunity of the Hour..... 271
The Master, the Mistress and the Telephone.....271-272
Which is the More Desirable?..... 272
Telephony Two Years Old..... 272
General Characteristics of Electrolysis.....273-274
Trade Notes 275-277
Personal 277-278
Review of Wireless Telegraphy—A. F. Collins.....279-288
Equipment of a Modern Exchange—F. A. S. Wormull.....289-291
The Telephone Status Quo—A. V. Abbott.....291-294
Operating and Governing an Exchange—A. L. Tetu..... 295
MANUFACTURERS' SECTION—
Chicago Telephone Supply Company.....296-311
W. G. Nagel Electric Company.....312-315
International Telephone Manufacturing Company.....316-319
Roth Bros. and Company.....320-321
New Standard Transmitter 322
Fisk-Newhall Telephone Manufacturing Company..... 323
Sullivan Telephone Exchange 324-325
Central Energy Telephones for Mines..... 325
Monarch Dry Battery Compact Telephone..... 326
A New Manufacturing Concern..... 327
Advance Magneto and Switch Hook..... 328
Saving Twenty Million a Year—V. A. Sears..... 329
An Illustration of Growth 330
Modern Telephone Protection—Frank B. Cook.....331-334

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

The Interstate Independent Telephone Association was organized in April of the present year at a convention held at the Sherman House in Chicago. The association embraces the upper Mississippi valley states, which are the home of more Independent exchange companies than any other territory of similar size and population in the Union.

If there is any section which, more than other parts of the country, is representative of the great Independent movement it is the Interstate Association group of states. There the Independent movement first found encouragement in the popular mind, and there the great Independent telephone manufacturing industry was born. The Interstate territory is and has ever been the battleground on which have been fought the most decisive conflicts between monopoly and Independence. Sufficient time has not yet elapsed to surround the history of the great anti-monopoly movement with the halo of historical tradition, but in years to come, when the crudity of the early Independent telephones shall have been succeeded by that perfection toward which the present is so rapidly tending, the field of Independent telephony will find its history chiefly written in the annals of the Independent struggle in the Interstate territory.

It is peculiarly fitting, therefore, that this part of the United States, so rich in past successes, so promising of future achievements, should be the home of the greatest Independent telephone association and the meeting place of the conventions which represent the progress made by the telephone companies of the great middle West.

The Interstate Association stands for all that is practical and modern in Independent telephony. It represents the young and vigorous business life of the Northern central states. It is energetic, prosperous, active and wide awake to its possibilities. Reforms are welcomed, but the tendency is toward a wise conservation in methods of operation rather than toward the exploiting of new ideas and theories. In a word, the Interstate Association is a thoroughly American organization, with all the American patriotism and enterprise which have made the name American a synonym for progress.

At the Interstate convention to be held at the Auditorium in Chicago on December 9, 10 and 11 will be gathered together the largest number of Independent operators in the history of the Independent movement. The gathering will be a sort of love feast and experience meeting, a clearing-house of good fellowship and helpful ideas. That the convention will be a great one is certain. It will be great in attendance, in enthusiasm and in power for good. It will be attended both as a duty and as a pleasure and will do more to strengthen and broaden the great Independent movement than any other convention ever held.

The Interstate Association was organized as a local organization, but at its first meeting it outgrew the plans of its founders and to-day is looked to by Independents everywhere as the young giant of the West, in whose acts and prospects are embodied all that is best in the Independent field. The National Association has found in the Interstate an ally of great strength and helpfulness, the operator in every state in the Union has been helped by the practical suggestions emanating from the first convention's work. It is to be hoped that similar associations will be organized in other sections of the country having a scope broader than that of the various state associations, but it is doubtful if anywhere there could be found so fruitful a field of effort as that covered by this young Western association.

The Auditorium convention will make Independent history and it should be considered a privilege and an obligation by every exchange man to be represented at the meet-

ing. In its general representativeness lies most of the association's strength. It is to be hoped that the coming meeting will even surpass the expectations of its most sanguine supporters.

THE OPPORTUNITY OF THE HOUR.

At the National Convention held in the month of June, 1899, in the same hotel where the Inter-State Association will hold its convention this December, an earnest effort was made by certain members to bring about concerted action looking to a gradual increase in the rates for service charged by Independent companies. This movement was editorially endorsed by the *Telephone Magazine,* then the only telephone publication, and one of its editorials, based on a thorough study of the situation, was referred to during the discussion. This increase in rates was felt to be an absolute necessity before the securities of Independent telephone companies could have the desired standing in the financial world. An earnest protest was also voiced against the acceptance of any more franchises limiting the residence rate to $12. And it was held by those promoting the subject that a combined movement on the part of all the members of the Association would effect radical changes. But the friends of certain manufacturers and contractors held that it was unwise to openly discuss a subject that the Bell would not be slow to use to the detriment of Independents, and these opponents rallied sufficient influence to shut off the discussion with scant courtesy.

Events occurring all through this year plainly indicate that there is no subject so vital to the continued prosperity of the Independent movement or one so far-reaching in its beneficial effects on the future stability of investments in Independent exchanges, as a marked increase in Independent rates. Thus here is "the opportunity of the hour." Have the members of the Inter-State Association the courage to bravely face the situation that is growing more desperate each month, and intelligently and broadly discuss this subject? If they will do this, they are "the men of the hour," and to the Inter-State Association will belong the honor of having built a solid foundation from which Independent telephone securities can appeal to the investor. If the subject is taken up there should be no hesitancy shown in bringing out all the facts, for fear the truth may offend this contractor or the promulgation of certain statements may lead that manufacturer to withdraw his support from the Association. For the Association is far better off without than with the support of contractors or manufacturers who are using it only to promote their own projects. Moreover, all that can be said during the discussion can in no wise benefit the Bell more than will the following statements by the presidents of two of the largest Independent organizations in this country.

The Cleveland *Leader* of November 9, 1902, contains this interview with Mr. F. S. Dickson, the new president of the Federal Telephone Company: "What is true of Cleveland is also true of these other cities," said Mr. Dickson to a *Leader* reporter. "We are not charging enough for the service we give. Here is the whole thing in a nutshell. We did not figure on the enormous increase in business. Instead of doing business with 1,000 persons, we found we were doing business with 10,000. Every new telephone that is put in adds to our indebtedness and makes operation more costly. As the number of telephones increase, the number of calls multiply in proportion. It is a fact that we could cut off 2,000 subscribers from our list and make money and could make more money if we cut down our list to 5,000. The Cuyahoga Company has a total of 10,072 telephones in all its exchanges."

The Baltimore *Sun* of April 29,1902, contains the statement that President Bouton made to the city council: "It has been found that, contrary to almost all other kinds of business, the operating expenses per telephone increase with the number of telephones in service, for the reason that, as the number of telephones increases the amount of use to which each telephone can be put is correspondingly extended, so that the operating expenses per telephone of the Maryland Telephone & Telegraph Company's Baltimore plant are more than twice as much as those owned by the same company in exchanges located in smaller towns. The investment per telephone is also increased, for the reason that greater numbers of trunk lines between the exchanges are needed and the construction of the switchboards is much more elaborate and expensive. This increased cost of investment means not only additional interest charges, but increased maintenance, an item of very large expense in the telephone business. One of the reasons why the cost of operation is expensive in a large city is the enormous service to which the busy telephones are put, such as those located in express and railroad offices, banks and large business houses. Many of such telephones average 50 calls per day, or the enormous total of 15,000 calls per annum. Under the present ordinance not more than $48 can be charged for such telephones, making an average in many cases of less than one-third of a cent a call. *This is far less than the cost of the service."*

THE MASTER, THE MISTRESS AND THE TELEPHONE.

Ever at his elbow the master keeps that indispensable factor in the successful promotion of every line of industry, that essential element in the upbuilding of financial and professional prestige—a telephone. Marvelous is the saving in time and labor and steps that the telephone effects for the master. By its general use commercial conditions and methods have been revolutionized; for the telephone has simplified the placing of orders, the making of engagements, the closing of large transactions, and minimized the necessity for business trips.

If so simple a device as the telephone has accomplished all this for the master, will it not prove relatively as serviceable for the mistress? And in benefiting the mistress will it not enrich the life of the master? For on the intelligent and prompt fulfillment of the seemingly endless duties of the mistress depends the comfort, the health and the happiness of the home life.

The master has never found any device or appliance superior to the telephone for facilitating the prompt, accurate and satisfactory dispatch of his affairs. And if the responsibilities and the duties of the mistress are as exacting in her own sphere as those of the master, why should she not utilize the same public-service function?

With so useful a helpmeet in her home it requires but a simple movement of the hand for the mistress to set in motion the mechanism that instantly places her in communication at any hour of the day or night with the family physician, the fire department, the police authorities, or with the master himself, even though he be in a distant city. In other words it affords a sense of security and comfort and protection worth many times its small cost.

But that is not all it does—a telephone in the home obviates the necessity for dressing for the street in the early morning, and enables the mistress to complete her marketing in less than twenty minutes; to avoid using wet sidewalks and muddy crossings in disagreeable weather, and to dispense with the annoyance of riding to market in crowded stuffy cars. Thus in this respect it repays its cost in the car fare it saves, to say nothing of its convenience.

Then many a butcher and baker and grocer exercise much care in the selection of goods ordered by telephone. And after one experience none desire to be delinquent in deliver-

ing these orders; for the mistress can be many times more emphatic when standing before an inanimate telephone than when facing a smiling but tardy grocer.

With a telephone in the home the mistress can call up the box office and have the desired seats reserved for opera or play, and can then arrange her theater party at her leisure and even fill unexpected vacancies at the last moment. Or in the event of illness or of an accident, can easily cancel all her invitations at the eleventh hour.

If a member of the family is stricken with illness, the telephone not only places the mistress in instant communication with the physician, but conveys his prescription to the druggist who quickly prepares and then delivers it by messenger. Thus, what the telephone saves in time, in anxiety and in nerve force, more than offsets its slight cost.

No wonder that housewives who have enjoyed that sense of comfort, of ease and of security that is the accompaniment of a telephone in the home, deem it as essential a part of the housefurnishings as the range and the refrigerator; or that many a mistress earnestly states that while doubling the pleasures of life a telephone in the home halves the discomforts.

Numberless are the reasons why there should be a telephone in every home; but none are seemingly so potent as the simple fact that it earns its own cost many times over in the car fare it saves. Yet a reason that should appeal more quickly to the master who studies the welfare of the mistress is, that a telephone weaves about the home a sense of security, of comfort and of helpfulness, the value of which who can estimate?

WHICH IS THE MORE DESIRABLE?

Capital is excessively timid. It holds aloof from movements wherein destructive dissension and discord abound, and seeks fields where harmony dwells. Never has money appeared so plentiful as now and yet rarely has there been a period in our financial history when it was quite so difficult to float new securities. Now, no field presents quite so attractive a view to many investors as the Independent telephone field. There is ample room for unlimited capital. Though a hundred millions were ready for investment tomorrow, it would not suffice to cover this field and would only make more apparent the need of still greater investments. Thus Independents who have the best interests of the movement as a whole at heart, will keep close guard over any move to advance ambitious desires to dominate the movement as a whole, until after the present financial flurry has passed. When investors have again grown less cautious about observing a lack of harmonious action, will be time enough to make radical changes in methods that thus far have found their highest tribute in the magnitude of the movement as a whole.

TELEPHONY TWO YEARS OLD.

With the present number TELEPHONY closes the second year and the fourth volume of its history. We close the books of our past efforts and turn our faces hopefully toward the future, but even in the bright prospects of the days to come our eyes linger on the record of what we are leaving behind us. From the little magazine that two years ago was first offered to the telephone world, TELEPHONY has grown to what it is to-day, the recognized and admitted leader among all Independent telephone papers.

Flushed with our past victories and rejoicing in our present strength, we yet regret that the struggles and trials of the past two years are behind us. There is much in TELEPHONY's history that we would have done better, if we had it to do over again; looking back on the twenty-four issues of our paper we see many things which we could improve and strengthen, but even our mistakes and crudities, viewed in the blended light of past, present and future, are better as they are, and we are not sorry that they have mingled with the good.

TELEPHONY is the fruit of years of planning; planning which could not fully understand the needs of actuality until confronted with the problems which arose from day to day. It has been cast and recast in the workshop of experience, inspired by the eyes of criticism and tested by the trials of time. That it is far from perfect no one is more willing to admit than we. We hope that we shall never be able to accomplish so much that there will remain nothing to be done. We shall improve from month to month, from volume to volume, and from year to year. Now that the foundation is laid, we shall build more slowly, carefully and better. The haste and inexperience of our earlier work has been gradually giving way to the more finished product which a better and riper knowledge of Independent telephony has made possible for us to produce.

With regret we say, we put behind us the four volumes which measure the two years of our life; regret that we shall not again in so full a sense, realize the blessing of such friendships as we have known. In the days when everything was an experiment and we awaited with anxious minds the verdict of the public, there came to our support with encouragement, good cheer and helpful counsel, a multitude of friends. Words fail and are powerless to express our appreciation of the kindness we have received from loyal subscribers and advertisers alike, such kindness as is far beyond our deserving. Now as we begin our third year, when our efforts have been crowned with the laurels of success, we pause a moment to live again in fancy the two years that are gone.

TELEPHONY's beginning in January, 1901, was humble but ambitious. Our first issue contained twenty-six pages of reading matter and twenty-six pages of advertising. Within three weeks after our first issue we had enrolled upon our books nearly two thousand subscribers. Our second and third issues resulted in a further increase of two thousand readers, and at the time of the publication of our fourth monthly effort, there were nearly five thousand regular subscribers to TELEPHONY.

Since that time the growth in our subscriptions has been little less than marvelous, and as month succeeded month, not only did our paper increase in size and improve in quality, but the circle of our friends grew steadily and rapidly larger.

Keeping pace with the increase of our circulation has been the constant augmentation of our advertisers. No trade paper in the world, in any field, contains a larger percentage of the actual manufacturers who devote their energies to a particular line than TELEPHONY, in its chosen field. The volume of its advertising is always an index of the value of a trade journal to its subscribers. Conversely, upon the size and quality of its subscription list, depends the quality of its advertising.

TELEPHONY possesses the double qualifications of the largest subscription list and the greatest amount of advertising published, in the telephone field. For this we thank our friends who have vouchsafed to us their hearty and unswerving support.

We will do better in the future than we have done in the past. Our lesson of experience will teach us how best to accomplish the tasks of the work we have before us. We can only say that we shall do our best.

Finally, as we close this second year, we hope that we may receive the help and good wishes of those who in the past and present we have called our friends, and that to their number may be added many new ones. To all of whom we extend our warmest thanks and the season's compliments.

GENERAL CHARACTERISTICS OF ELECTROLYSIS

By Harry S. Coyle.

There are, no doubt, many people who associate the term "Electrolysis" with the forces of destruction and put no other definition upon it. While electrolysis is the direct cause of much destruction, especially to the delicate mechanism of telephone apparatus, its beneficial action is of such great importance and gives birth to such a grand and far-reaching study as electro-chemistry that its destructive action is of little importance compared with its usefulness.

Its influence upon the arts and sciences of civilization is of such great magnitude that it can hardly be over-estimated. In fact it is to electro-chemistry that we owe some of the great discoveries of electricity. The principal value of electro-chemistry lies not only in its commercial applications, but in its bearing upon the theory of electricity; I have but to mention the "ionic theory," and the "election," which is the electric charge, divorced from its accompanying matter, to show the value of electro-chemical research.

The discovery of electrolysis was the signal for the commencement of a brilliant series of experiments by some of the most distinguished scientific men of the age whose labors are symbolized by their achievements, which are expressed by an almost endless variety of the applications of electricity. The origin of electrolysis is said to be with Daniell, who noticed the deposit of copper while experimenting with the cell that bears his name. Jacobi of St. Petersburg first published a description of the process in 1839. Elkington was the first to put it to any practical use. In 1800 Nicholson and Carlisle discovered the important fact that an electric current when passed through water could decompose it into its constitutional elements and later on Berzelins and Hisinger decomposed salts into "acids" and "bases" by means of the electric current, thus laying the foundations for electro-chemistry. The results of these experiments led chemists to believe that a close relation existed between the electric energy and the affinity which held the atoms of chemical compounds in combination.

In 1807 Day propounded the theory that all compounds consist of two portions, one electro positive and the other electro negative. Berzelins advanced the fact that the polarity of an element or group of elements could be determined by noting whether the element or group separated at the positive or the negative pole. The fact that the galvanic current splits compounds in solution into two portions; one electro positive and the other electro negative, gave a great impetus to analytical chemistry.

To Faraday belongs the credit of establishing and coining the nomenclature of electrolysis; he gave the name of electrolysis to the process of decomposition of compounds in solution by the agency of the galvanic current, the substance so decomposed is known as the electrolyte, the conductors immersed in the fluid are termed the electrodes; anode is the electrode corresponding to the positive pole, while cathode is the electrode corresponding to the negative pole. *Ions* is the name of the substances that are produced by the agency of electrolysis and which are divided into *anions* and *cations,* according to their appearance on the anode or cathode poles.

When compounds are subjected to electrolysis the constituent elements are not discharged throughout the mass, although the decomposition occurs at all points between the electrodes. In compounds made up of two elements only, one element is given off at each of the poles, entirely unmixed with each other, and always from the same pole. Thus, it hydrochloric acid be subjected to electrolysis, pure hydrogen is given off at the negative pole and pure chlorin at the positive pole. In the case of compounds containing more than two elements, a similar decomposition occurs; one element being liberated at one pole, and the remaining group of elements at the other pole.

All substances are composed of very minute particles of matter known as molecules, which is the unit of the compound; these molecules are in turn composed of still smaller elementary particles of matter called the atom, which is the unit of the element. In every compound there exist a number of free atoms or groups which are called ions. These ions have a tendency to collect themselves around the electrodes. These free atoms or ions are possessed of a static charge of electricity by which they are attracted to the oppositely charged electrode. The same ions or radicals may be single atoms or compounds which act as radicals chemically, and they may even be incapable of existing in an actual separate state.

Hydrochloric acid is an electrolyte composed of two single atoms, namely, H. and Cl. Sulphuric acid, $H_2 SO_4$, is composed of two atoms of hydrogen, which composes one ion, and the compound radical SO_4 sulphur dioxide, which composes the other. This radical cannot exist uncombined, so that sulphuric acid, $H_2 SO_4$ is an electrolyte only when in the presence of something or can react on and combine with such as water, although water, $H_2 O$ itself is not an electrolyte. The same ions may belong at different times to the cation or anion class, *if* united to one having a higher individuality in either direction, for there is no direct attraction between the electrodes and the ions themselves, but the relation depends simply upon the temporary polarity they assume in the circuit.

The electro-negatives or acid radicals are oxygen, chlorine SO_4, etc. The electro positive or basic radicals are hydrogen and the metals. There is a force which resides in all of the elements which guides their formation. Bodies that are endowed with the power of attracting other bodies are said to be electrified; bodies oppositely electrified attract each other.

Chemical affinity is accomplished by virtue of the electrical attraction that is exerted between the atoms of oppositely charged elements. This electrical attraction is the result of the action of the *ions,* or more properly the *electron* which may either be a positive or a negative charge of electricity, according to its polarity.

In chemical compounds the different elements which are known as radicals seem to be possessed of definite electrical characters and are given off at one or the other pole in preference. Those elements which are given off at the positive or platinum pole are said to be negatively electrified and are therefore known as the electro-negative elements. Those given off at the negative pole are positively electrified and are known as the electro-positive elements.

Chemical combination is accomplished by the electrical attraction that is exerted between the oppositely charged elements that are brought within the sphere of electrical influence. Some substances are so highly charged that igneous fusion is necessary to break their bonds; liquifaction will cause decomposition in many cases; in some cases this electrical bond that holds elements in combination is so feeble that a ray of light or a slight jar will cause the decomposition of such compounds.

When the poles of a highly charged battery are immersed in a fluid compound, the weaker electrical force that holds the atoms in combination is quickly broken by the

greater attractive force exerted by the poles of the battery, in consequence of which the atoms rush to the poles; the native-charged atoms go to the positive pole, while the positive-charged atoms go to the negative pole, and it is thus that electrolysis is accomplished. The electric current may cause chemical action directly by electrolysis, or indirectly by its heating effect. An electric current has no chemical effect while passing through a solid conductor; when the current passes through any liquid conductor other than an elementary substance, such as a melted metal, the liquid is decomposed and chemical action is manifested at one or both electrodes. Gases seems to conduct electricity by convection, the atoms carrying positive and negative charges between the electrodes.

In some cases, especially where the gases are hot, there appears to be an electrolytic action similar to that occuring in liquids, causing the combination or separation of atoms to form new compounds. In some cases there is a secondary reaction, so that the atoms which were originally liberated by the current form other combinations before they can be liberated at the electrodes. In many cases electrolysis is undesirable and would be prevented if practicable, as in the case of damage to underground metal pipes by street railway currents. In the case of damage to telephonic apparatus by electrolysis, there must exist a state of moisture, probably not in sufficient quantity to interfere with the mechanism of the conductors, but enough to cause electrolysis.

Electrolysis is an insidious process and will do much damage before we are aware of its presence.

The telephone systems of the Bell companies at New Orleans, Memphis and Nashville were so seriously damaged by the action of electrolysis a few years ago as to necessitate the installation of new switchboards in those cities. The wires and other conducting apparatus used in switchboard work are composed of various compounds which of course contains the electro-positive and the electro-negative elements; these conductors with the addition of a slight degree of dampness offers a prolific field for the action of electrolysis. Corrosion is a word used among electrical workers in place of electrolysis—it is the common name for that process. We often hear people say that a wire has become corroded and to better illustrate their meaning they will show you the wire covered with rust; this rust is the product of the action of electrolysis; it is a non-conductor of electricity and greatly reduces the capacity of the wire as a conductor by virtue of this resistance. Another weak spot for the action of electrolysis is soldered joints, especially if the joint is poorly made. This is a great source of trouble on lines carrying high voltage, in addition to the electrolytic action, an arc is liable to occur. The arc gives off great heat and is the cause of the destruction of many buildings by fire.

LAWS OF ELECTROLYSIS.

1. The amount of chemical action is equal at all parts of the circuit, i. e., the chemical action is independent of the location in the circuit, provided the current is equal in all parts.

2. The amount of an ion or atom liberated in a given time is proportional to the strength of the current.

3. The amount of an ion or atom liberated at an electrode in one second is equal to the strength of the current multiplied by the "electro-chemical equivalent" of the atom.

4. The first two laws mean the chemical effect produced is proportional to the quantity of the current multiplied by the time, so that 10 amperes acting for one hour produces the same results as 5 amperes acting for two hours. There are certain facts which have been found to hold in all cases, but have not as yet been accepted as constant laws; such facts are: When the liquid contains a metallic compound in solution the metal is usually deposited on the cathode and the remaining part of the compound is deposited on the anode.

Temperature variation of electrical conductivity and fluidity are identical for a given electrolytic solution, although temperature coefficients of fluidity and specific molecular conductivity are not identical, though the sets of curves possess considerable similarity. Heretofore physics and chemistry were considered to be independent branches of science, but now they are found to be very closely related and through the action of electrolysis. Electro-chemistry has taken great bounds in the last six years on account of its intimate connection with electricity and the arts. Chemical industries are growing rapidly and electricity is entering more largely into manufacturing processes. Potash and soda in particular are made in this way, the electrical current constituting the principal agent in their production. Nickel plating is accomplished by electrolysis, also silver plating and the fine finish of beautiful bronze are the results of the same process. Decomposition of salts by the electric current has been applied to important industries, which are classed as follows:

Electrotyping, by means of which impressions of coins, wood engravings, etc., are reproduced.

Electroplating, by means of which a base metal, such as copper, is covered with a superior metal, such as gold.

The reduction of metals from solutions of their ores, as in assaying ores.

The applications of the electric current to manufacturing chemistry are very important and numerous.

We owe it to Henry and Faraday that the electrical sciences were transferred from the chemical laboratory to the fields that they now occupy. Although electro-chemistry has been largely overshadowed by electro-magnetics, its progress has been no less substantial.

Henry and Faraday saw that electro-chemistry and electro-magnetics must each have its own sphere in order to attain their proper development. The mechanical devices that are necessary to the workings of electro-magnetics could never have been invented in a chemical laboratory.

The chief value of electro-chemical research lies not in its commercial applications, but in its bearings upon the theory of electricity.

These sciences exist not like so many distinct things, but they environ one another—there exist the most intimate associations among them. Heat and light are not now considered as separate things, but simply different manifestations of electricity.

Prof. J. J. Thompson has recently revealed a particle of matter 1-1000 the size of the hydrogen atom, which was hitherto the smallest particle of matter chemists have recognized. This particle of matter discovered by Prof. Thompson has been called by some scientists the "electron," by others the "negative particle." This is possibly the basis of a new theory of matter. The electron is the electric discharge divorced from its accompanying matter—it is the electron that flies with the velocity of light among the struggling molecules in the process of conduction through a wire and conducts our thoughts over hundreds of miles of wire. It would be a long but a beautiful story to tell about all of the wonderful discoveries and inventions that men have accomplished since the discovery of this wonderful electron. The X-rays, the connection between magnetism and light, the generation of the waves in the ether that renders wireless telegraphy possible, the secret of the generation of light, have for their foundation the electron, which exists in all matter. So electricity is the connecting link that binds all matter together.

At first sight there would seem to be little if any connection between telephony and electrolysis, but a closer view will reveal the important fact that the gentle galvanic current which flows from the storage batteries is generated by electrolysis.

TRADE NOTES

S. H. Couch Company, Boston, Mass., has removed to 156 Pearl street and makes the announcement that it has outgrown its old quarters.

The D. M. Fulmer Lumber Company has recently established headquarters in the Merchants' National Bank building, Chicago, still operating its yards at Florence, Wis.

Houston & Liggett, Lewisburg, Tenn., well-known wholesale dealers in cedar poles, has purchased the business and good will of the Tennessee Lumber Company of the same place.

The Monarch Telephone Manufacturing Company, 35-41 West Randolph street, Chicago, is issuing its new "Bulletin No. 2," containing 32 pages profusely illustrated, which is devoted exclusively to telephone parts.

The Eastern Carbon Works, Jersey City, N. J., manufactures superior dry cells and batteries. It guarantees its products to be equal to any other manufacturer's, claiming for its dry cell that it will give double the service of any other.

The Sumter Telephone Manufacturing Company, Sumter, S. C., is enjoying a large demand for its new line of small switchboards and has recently issued a descriptive bulletin describing same which will be forwarded upon request.

The Haines & Noyes Company is meeting with great success in placing orders for its "Hanoy Jr." one-wire telephone. Messrs. Schlesinger & Mears, the New York managers of the company, are located at 220 Broadway and report large sales of this instrument.

The Manhattan Electrical Company, Chicago and New York, reports a very flattering fall trade in telephone construction material. This company is constantly increasing its stock to meet the demand in order to maintain its well-earned reputation for prompt delivery and good goods.

The Phoenix Glass Company has removed its Chicago office and salesroom to No. 206 Wabash avenue. A complete line of samples will be on exhibition at this place, and a cordial invitation is extended to the trade to visit the company's new quarters. Mr. E. H. Fox is the Western agent.

The Central Electric Company, 264 Fifth Ave., Chicago, has recently issued a new general catalogue dated 1903 and has distributed it to the trade throughout the country. Every buyer of electrical supplies who has not already received a copy can do so by addressing a request to the Central Electric Company.

The Eureka Electric Company, Chicago, announces to its many friends and customers that in its headquarters in room 656 in the Auditorium will be found, during the convention, the latest products manufactured by this well-known company. The exhibit will be in charge of Messrs. I. J. Kusel, H. J. Kusel, D. L. Canmann, H. Rosenow, C. W. Robbins, Paul Gardner and others. Handsome souvenirs will be given away. The exhibit will embody special features of the latest and up-to-date improvements in the products of telephone apparatus. Remember the number of the room—656.

F. J. Lamberson, 173 S. Clinton St., Chicago, is placing on the market a polishing cream especially adapted to cleaning telephones and switchboards. It is claimed by users that this polish is unsurpassed for the purpose intended. Mr. Lamberson will send a sample bottle to any one mentioning Telephony.

The Deveau Telephone Manufacturing Company, New York city, has furnished a complete telephone exchange equipment to the Trinidad Electric Company, and the same has been shipped to Trinidad. This company has also furnished the United States government with a complete central energy plant for the Puget Sound naval station, Brennington, Wash.

The Selectaphone Manufacturing Company, Wheeling, W. Va., will exhibit its Selectaphone at the forthcoming convention. The Mountain State Electrical Company of the same city will exhibit its apparatus, occupying the same room with the Selectaphone Manufacturing Company. An invitation is extended to all visitors to inspect the apparatus of these companies.

The Moon Manufacturing Company, 43-49 South Canal street, Chicago, desires to call special attention to its advertisement in this issue of Telephony advertising Moon terminal heads for telephone cables. The company claims that this justly celebrated terminal protects something like 250,000 telephone line wires and that it has had no losses reported, which ought to be sufficient evidence of "a remarkable record."

James S. Barron & Company, New York city, are the sole agents for the Harloe self-tying insulators. These insulators are made in porcelain and glass for outside and inside construction for telephone and telegraph, electric light and power purposes. These insulators can be put on with great rapidity and their special construction doing away with the use of tying wires is making them very popular in this field.

The North Electric Company, Cleveland, Ohio, manufacturer of telephone instruments and switchboards, is now well established in its commodious new factory. The first floor of the building is entirely occupied with private offices and the counting-rooms and the upper floors of the building used for manufacturing purposes, one floor being entirely given up to switchboards, and the other features of telephone manufacture are well departmentized.

The W. G. Nagel Electric Company, Toledo, Ohio, has the following bulletins ready for distribution: No. 2, Treating on wires, ropes and cables. No. 3, giving complete list of pole line construction material. No. 5 containing complete list of "Ready pole seats, balconies, cable arms, cable cars, cable trolleys, pay-out reels and construction tools. Estimate blanks giving complete tabulated list of material required in the building of an up-to-date exchange supplied free.

The Eureka Electric Company, Chicago, Ill., is receiving a great number of inquiries with regard to its switch hook—which is one of its latest developments—and also its new transmitter. This switch hook and transmitter have special features which eliminate some of the difficulties which are claimed to be inherent in many types of apparatus. The transmitter does away entirely with the

mica auxiliary diaphragm, and it is claimed that an equivalent result is achieved in a new and novel manner. This company is distributing a number of cards illustrating in colors different types of apparatus. These are very attractive and will be sent to any one interested upon request.

THE MONARCH ELECTRIC & WIRE CO., 125-127 S. Clinton street, Chicago, invite all visiting convention delegates to make headquarters at its offices, assuring all the comforts of home. The company's specialty, aside from being royal entertainers, is insulated iron wire of the Monarch brand.

VALLEE BROTHERS ELECTRICAL COMPANY, 625 Arch street, Philadelphia, Pa., is sending to any one interested two splendid catalogues on telephone apparatus and electrical house goods. These would seem to cover a range of everything which could be looked for in small electrical apparatus, applying to hotel annunciators, telephones, telegraph instruments, batteries, construction materials, wires and cables and a great many other electrical devices.

THE CHICAGO WRITING MACHINE COMPANY, 119 La Salle St., Chicago, is manufacturing the Chicago Telephone Holder, an indispensable device to the telephone user. The company claims that this holder cannot get out of order. It is adjustable to any position, and can be placed on either side of any kind of desk and fastened to a wall or partition, and is strong enough to hold many times the weight intended for it. The holder is also adjustable to any size telephone base.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 Market St., St. Louis, Mo., is supplying most of the electrical appliances for the World's Fair. The first car load of material received by the World's Fair directors contained boxes of porcelain knobs, cut-outs, branch blocks, cleats, and other electrical fastenings. It was the first of eleven car loads which will be necessary to equip the lighting lines of the exposition. Chief Electrical Engineer Ruston states that 1,492,250 wiring knobs will be required.

THE GORDON BATTERY COMPANY, 439-445 East 144th street, New York, manufacturers of the well-known Gordon cell strikingly illustrated on page 112 of this issue, makes strong claims for the efficiency of this battery for telephone work—central energy, switchboard transmitters, subscribers' stations, etc. Simplicity of construction, cleanliness, guaranteed long life and easy to recharge are the dominant features of this battery. The company issues a very neat and clear booklet illustrating the Gordon cell, which they would be glad to send on request.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY has recently established a new factory at 187 Pratt street, Buffalo. The purpose of running a factory here was with the idea of being nearer the Atlantic coast electrical interests, and also because the company's business has so rapidly increased during the last few years as to practically grow beyond its Chicago manufacturing facilities. The company continues its office at 358 Dearborn street, Chicago, and also its Chicago factory, and also maintains an office at 853 Broadway, New York.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, New York and Atlanta, is mailing pay envelopes to the trade indicating on the surface that the envelope incloses $500.30. The announcement contained in the enclosure states that the $500 represents the minimum dividends which the American protector will earn in one year for an exchange of one thousand subscribers, and the 30 cents represents what you will feel like if you do not protect your exchange with "protectors that protect." A sample fuse and order blank is included in each envelope.

THE CHICAGO NUT COMPANY, 207 South Canal street, Chicago, is endeavoring to interest all users of hexagon brass nuts in its product. The hexagon nuts produced by this company are of superior quality and are used extensively by many prominent manufacturers. The company also makes lock-nut binding posts and various other electrical appilances, among which is its Marlin cable hanger, for which it has a great demand. Samples of nuts and cable hangers will be forwarded to users of these goods.

THE W. G. NAGEL ELECTRIC COMPANY, Toledo, Ohio, has recently put on the market a duct rod, which embodies several new features. The method of coupling and uncoupling is best shown by illustration, one portion being inserted in receptacle of the other, automatically locking the two rods. To uncouple, it is only necessary to push spring in the coupling. It is impossible for rods to become uncoupled in conduits. Another feature of the "Ready duct rod" is that they can be coupled and uncoupled as fast as rods can be inserted. Couplings are made of malleable iron, rods of second growth hickory, one inch in diameter, made in any length desired. The company will be pleased to send sample rod for inspection, and prices as requested.

THE STUART-HOWLAND COMPANY, Boston, Mass., owing to the rapid growth of its business, has been compelled for the third time in eighteen months to materially increase its quarters. The latest addition includes the entire premises until recently occupied by the Pettingell-Andrews Company. This will give it about 30,000 square feet floor space and when remodeled, according to projected plans, will make a store and offices of very excellent facilities. The location, Devonshire street and Whitworth square, is in the heart of the busiest section of Boston, within easy access of street car lines from all the prominent points. This company started in business less than three years ago and its growth has been marked. The business is now one of the largest of its kind in the country.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has been awarded the contract for the apparatus for a municipal telephone system for St. Petersburg and Odessa, Russia. The St. Petersburg contract is said to be the largest ever awarded to any telephone manufacturer. The switchboard is of the two-division, lamp-signal, full common battery type and will have an ultimate capacity of 40,000 lines, the present equipment being 12,000 telephones. The full equipment required by the Odessa proposition has not yet been learned, but the city has about 400,000 inhabitants and this contract will undoubtedly be a very large one. All the apparatus is to be furnished of the latest Kellogg type, and the order has been secured in competition with many of the prominent manufacturers in Europe and the United States.

THE COIN CONTROLLER COMPANY OF AMERICA, Winner building, St. Louis, Mo., has issued a neat little pamphlet describing its coin collector, a small metal box three by four inches, which is screwed against the wall beside the telephone. A slender steel lever projects over the fork which holds the ear trumpet, preventing it from rising until five cents is deposited in the slot. Connection cannot be had with central until the lever which holds the ear trumpet rises. As in all telephones, there is a switch which makes the connection. On depositing a nickel in the slot the lever rises, giving connection, and when the ear trumpet is hung

up it locks automatically. The renter of the telephone has the key to the box and gets the deposit. The device appeals strongly to parties who rent telephones that are used largely by individuals who do not share in the rental.

THE CHICAGO TELEPHONE SUPPLY COMPANY, Elkhart, Indiana, has issued a very comprehensive and artistic new catalogue of sixty-four pages, illustrating its apparatus. If you are interested ask the company for its catalogue, No. 41, which is full of argument and essential reasons why "Chicago Telephones Satisfy."

THE CALCULAGRAPH COMPANY, 9-13 Maiden Lane, New York, introduce the calculagraph to TELEPHONY readers this month. Calculagraphs for telephone service form an important factor of the business. It calculates and prints elapsed time in minutes and quarter minutes, has visible dial and records the time of day. In many other fields of endeavor it is indispensable. The company invites correspondence and has a number of interesting booklets describing the instrument and its adaptability to many trades and purposes.

THE ILLINOIS ELECTRIC SPECIALTY COMPANY, 170 East Madison street, Chicago, has supplied the trade with another advertising announcement during the past month. This company, while devoting its best efforts to the production of electric specialties, finds time to introduce clever specialties in the way of advertising. The card sent out recently is a reproduction of a miniature turkey tied up in a paper bag attached to a card. As a matter of fact, the paper bag contains a circular calling attention to the Illinois electric specialties, with the admonition not to miss the stuffing.

THE STANDARD POLE AND TIE COMPANY, 44 Broad St., New York City, will move its North Carolina office from Maxton to Wilmington. The company has had offices at Maxton for the past two years, but it now appears that it will be more to its advantage to have the office located at Wilmington. J. W. Davis, manager, will have personal charge of the shipment of octagonal and juniper poles from that section and will also have supervision of the inspectors who inspect personally every carload of material before it is shipped. All communications relative to the purchasing of material should be addressed to the New York office of the company in the future as in the past.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., has increased its business to such an extent that its already large plant is rapidly becoming over-taxed, and plans and preparations are now being made to increase the capacity. This company has enjoyed a constantly increasing demand for its products which are now so well and favorably known to the large fraternity of telephone buyers in the United States, Canada, and foreign countries. The factory is considered one of the most completely equipped in the business, and in addition to every modern facility in the metal working and assembling departments, operates a saw-mill and cuts from native timber all the hard woods used in cabinet work. This company manufactures both common battery and magneto systems, but make a specialty of magneto apparatus. The heavy capacity generators are particularly efficient and well constructed, and it is said the toll-line instruments are in much demand. It has recently introduced a line of small toll-line switchboards adapted to farmers' line service, that have become deservedly popular. The celebrated Sumter "Bulls-Eye" Express switchboard equipped with patented *inwardly* falling self-restoring shutter combined drop and jack, have been furnished for a large number of exchanges, ranging from one hundred to one thousand drops capacity. The officers of this company are: C. T. Mason, president; F. C. Manning, vice-president and secretary, and C. G. Rowland, treasurer. The remarkable development of the business is a fitting evidence of their energy and liberal knowledge of the requirements in modern telephone apparatus, and their ability to produce it. Mr. Mason, who is also the company's chief electrician, is well known as a mechanical and electrical genius. Many patents have been allowed him on his various inventions.

PERSONAL

L. G. Bowman is now associated with the North Electric Co., Cleveland, O.

E. B. Perry, representing the F. Bissell Co., Toledo, O., was a recent Chicago visitor.

Frederick Bissell, president of the F. Bissell Co., Toledo, O., was a caller at TELEPHONY headquarters in November.

Frank G. Jones, president of the American Electric Fuse Company, Chicago, has been a recent visitor to New York.

Frank Haflinger has succeeded Harvey White as inspector for the Citizens' Telephone Company at Pekin, Ill.

W. A. Taylor, representing the Standard Telephone & Electric Co., Madison, Wis., was a recent Chicago visitor.

Messrs. Brown, McKaig and Hughes of Blue Mound, Ill., were visiting Chicago manufacturing companies recently.

David I. Campbell has been appointed local manager for the Citizens' Telephone Company at Newcastle, Pa., succeeding a Mr. Tubbs.

John G. Pratt, formerly of Monroe, Ill., has succeeded Frank Virgin as superintendent of the Cass County Telephone Company at Beardstown, Ill.

Henry Abbott, president of the Calculagraph Company, 913 Maiden Lane, New York city, was among TELEPHONY's visitors during the past month.

G. A. Briggs, president of the Chicago Telephone Supply Co., Elkhart, Ind., and H. P. Didricksen of the same company, were Chicago visitors recently.

Fred B. Patten, president of the Illinois Electric Specialty Company, Chicago, has just returned from a trip covering the eastern territory of his company.

Harry Hare, manager of the Wapakoneta, Ohio, telephone exchange, is acting in the capacity of engineer for the Peninsular telephone system, with headquarters at Tampa, Fla.

Harry D. Reese of the Mount Sterling telephone exchange and Miss Olga Lee Moore, formerly of the Owingsville telephone exchange, were married at Owingsville, Ky., November 12.

W. G. Bowe, superintendent of the Marshall Telephone Company of Marshalltown, Iowa, has been offered the management of the Independent telephone company operating an exchange at Duluth, Minn.

W. H. Baxter, formerly of Ft. Madison, Iowa, where he held the position of local manager for the Mississippi Valley Telephone Company, has resigned to accept a similar position at Shenandoah, Iowa.

Thomas Bromley, Jr., has assumed charge of the Delaware and Madison County Telephone Company, Muncie, Ind. Mr. Bromley was formerly secretary and manager of the Union Telephone Company as Owasso, Mich.

Jas. S. Brailey, Sr., formerly of Wauseon, Ohio, has decided to locate permanently at Toledo. Mr. Brailey is one

of the heaviest Independent telephone operators in the country and has large interests in the Home Telephone Company of Toledo.

Charles L. Burlingham, president of the McDermid Manufacturing Co., Chicago, visited Detroit, Cleveland, Toledo and other important cities during November in the interests of his company, and reports a very successful business trip.

D. L. Berry, representing the International Telephone Manufacturing Company, Chicago, visited his old home at Jackson, Mich., recently. He is at present engaged in installing electrical apparatus for the new co-operative telephone company of Detroit.

Geo. H. Currie has succeeded L. A. Herrick as manager of the Freeport telephone exchange, Freeport, Ill. Mr. Currie was the first manager of the Freeport exchange and has a thorough knowledge of the business and will no doubt prove a very valuable man for his company.

G. M. Brown, local manager of the Home Telephone Company, Bloomington, Ill., will resign his position, to take effect December 1. His plans for the future are not definitely outlined. He has served as local manager for the Home company for the past three years.

F. L. Martin, who so successfully handled the advertising of the Kellogg Switchboard & Supply Company for the past year and a half, has severed his connection with that company and has assumed charge of the advertising department of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., and Chicago, Ill.

J. H. Quick has quit the practice of law to assume the general managership of the Iowa-Clark Automatic Telephone Company and the Nebraska Clark Automatic Telephone Company, with headquarters at Sioux City. Mr. Quick was formerly associated with the firm of Quick & Carter, attorneys.

Roy Sykes, who for the past few months has had charge of the New London telephone exchange, has been transferred to the management of the affairs of the local telephone company, Plymouth, Ohio. Besides having the management of the local exchange Greenwich, New Washington and other exchanges will come under his supervision.

Henry A. Everett, formerly of the Everett-Moore Syndicate, Cleveland, Ohio, has resigned the presidency of the Federal Telephone Company and also of the Cuyahoga Telephone Company and is succeeded in both companies by Frederick S. Dixon of New Jersey, who is connected with the John A. Roebling & Sons Co., Trenton, N. J.

G. W. Turpin, formerly in charge of the Independent telephone exchange at Sebree, has accepted the management of the Henderson Telephone and Telegraph Company, Henderson, Ky., succeeding J. W. Walker, who resigned on account of ill health. Mr. Turpin is a young man of splendid business qualifications and will no doubt fill the position with credit to himself and satisfaction to the company.

Fifty-six capitalists, representing an aggregate wealth of $200,000,000, visited Chicago early last month on a special train from the East. They are bondholders of the Illinois Telephone Company and their mission was to inspect the fourteen miles of tunnels already completed beneath the streets of Chicago and the extensive plant of the Automatic Electric Company at Morgan and West Van Buren streets. Among the owners of the new telephone and telegraph company are: Robert Jadwin, Carbondale, Pa.; Homer Green and H. Z. Russell, Honesdale, Pa.; G. Y. Flannagan, S. E. Innes, C. E. Johnson, C. E. Stegmaer, F. G. Stegmaer, Colonel G. N. Reichard, Dr. L. I. Shoemaker, P. A. Meixell, Liddon Flick, R. J. Flick and J. W. Hollenback, Wilkesbarre, Pa.; T. H. Phillips, Philadelphia; Colonel H. M. Boies, C. S. Weston, Edwin W. Bearhart, Byron Winton, T. E. Jones, Thomas Sprague, Grant Pelton, E. B. Eynon and Charles H. Welles, Scranton, Pa.; Colonel E. R. Payne and H. Collins, Williamsport, Pa.; M. W. O'Boyle, J. H. Foy, W. S. Staley and J. A. Law, Pittston, Pa.; Professor W. L. Dean and Dr. L. L. Sprague, Kingston, Pa.; E. B. Tustin, Bloomsburg, Pa.; Commander G. C. W. Lowry and Clinton W. Wisner, New York; C. F. Wright, Susquehanna, Pa.

TELEPHONE EXPANSION AND ECONOMICS.

The stationery of a telephone company bears the following declaration of principles on the subject of expansion, says the *Electrical Review*, which can be indorsed by all good citizens, irrespective of politics:

It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout its territory; and in all of the cities and towns to put a telephone, at the most reasonable rates, within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars.

It has never been shown that the cost of electricity is any exception to the general principle that two apples cannot cost less than one apple, and this fruit, which has held so important a place in human affairs from the incident in the Garden of Eden to giving Sir Isaac Newton the hint for the hypothesis of gravitation, may also be applied to the telephone rates of to-day.

It bears no good to anybody for a telephone company to attempt to furnish service at less than cost, and it is essential to both the telephone companies and the public that this service should be done at a price which is reasonable and fairly remunerative under conditions of good management.

Anything less than a remunerative price must detract from quality of the service and the condition of the apparatus, both of which are to the detriment of the telephone subscriber. Moreover, such losses must ultimately impair the capital invested and if such a method of doing business extends beyond a certain degree insolvency results, followed by the refusal of capital to invest in enterprises which should contribute to the good of a community.

When telephone systems have operated a few years longer there will be accumulated information as to the cost of the service, but there is nothing more deceiving to those new in the business than the expense caused by depreciation in the property and the necessity for renewals to keep pace with the march of invention.

A FRANCHISE GRANTED IN UTAH.

The city council of Salt Lake City, Utah, on November 24, granted a fifty-year franchise to the Utah Home Telephone Company, thus ending a long and bitter fight made against it by the Bell company.

The Home company numbers among its officers and directors Heber M. Wells, governor of Utah; John Henry Smith, brother of the president of the Mormon Church, and a number of prominent Mormon and non-Mormon business men of Salt Lake City.

The promotion of this enterprise has been in the hands of E. W. Hammer and associates of Chicago, with headquarters in the Monadnock block, and they are to be congratulated on this splendid victory over the Bell company.

The plans of the Utah Home Telephone Company contemplate a complete telephone system to cover the entire city of Utah, and with its powerful local influence and strong Eastern connections, it bids fair to become one of the prominent systems of the country. It is the intention to begin construction as soon as material can be delivered.

Review of Wireless Telegraph Engineering Practice.

A. Frederick Collins.

Wireless telegraphy has advanced with wonderful swiftness from the position of a scientific curiosity to that of a branch of applied electricity. It is apparently destined not to supplant pre-existing agencies, except to a very limited extent; but rather to perform new functions for which preceding means of electric communication were not adapted.

Mr. Collins makes the first complete survey of the field, showing what are the fundamental elements common to all systems, and what the special features of method or apparatus peculiar to each.—The Editors.

Recent developments in wireless telegraphy, theoretical and practical, have placed this latest and greatest triumph of modern science in the domain of electrical-engineering practice, for it is now possible to design apparatus for the transmission and reception of electric waves to a distance of 100 miles with as much certainty of result and accuracy of action as it is a 1,000-kilowatt alternator.

At the present time there are several companies engaged in the manufacture, sale and installation of instruments in the United States, in England, and on the Continent, and among the better known systems are those of Signor Guglielmo Marconi of England, Prof. Ferdinand Braun and Dr. Adolph Slaby of Germany, Mons. Emile Guarini Foresio of Belgium, Mons. E. Ducretet of France, Señor Julio Cervera Vaviera of Spain, and Prof. Reginald Fessenden and Dr. Lee de Forest of the United States.

Whilst all these systems of wireless telegraphy are based on the same fundamental principles, there is a vast difference in their electrical and mechanical construction, as will be observed by comparison; this difference is due in some cases to the applicability of divers devices which perform virtually the same functions, but in the greater number of instances, this variation is the result of widely divergent opinions resulting from theoretical consideration; and again, individual inventive ability figures largely in the apparatus personified by the names above.

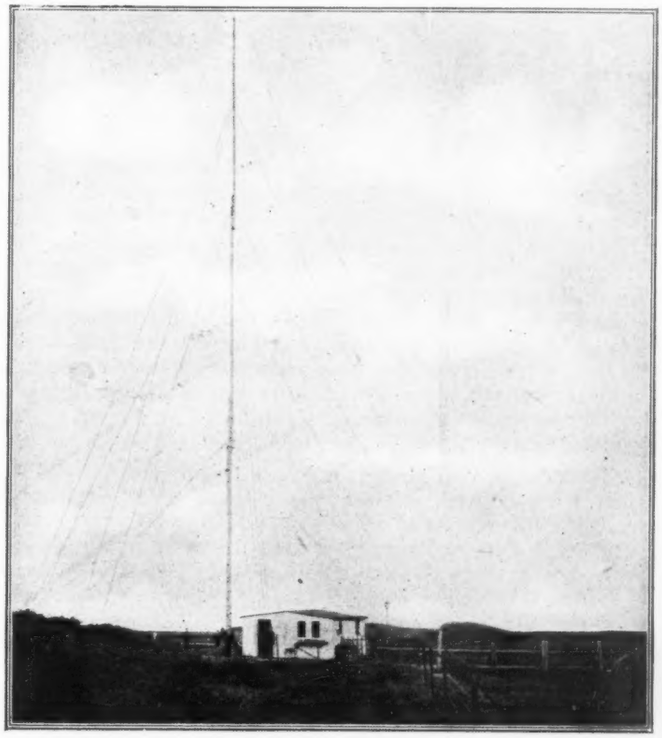
The greatest interest in wireless telegraphy at the present time, lies in the question of similarity of the component parts of the apparatus as a whole, for mighty legal battles will be waged in the near future with all the dynamic virulence which characterized the wars of the telephone companies, since priority of discovery and invention of the various workers and the commercial monopoly the patent rights grant to the different companies will be sustained by each, if possible.

Taking into consideration these three factors, *i. e.*, the scientific, the commercial and the legal phases of the art, the following text will be divided into three portions, the first of which will treat briefly the historical, the second dealing with the theoretical, and the last with the practical aspect of wireless telegraphy.

Historical—The history of signalling through space without wires may be said to date back to the time of Lindsay—when he transmitted and received messages across the river Dee in Scotland by what is now known as the conductivity method; from that year until 1896 a number of schemes were formulated and some of them were put into experimental execution, including the induction method of Preece and the electrostatic methods of Edison and Dolbear; but until Marconi introduced the electromagnetic wave system, wireless telegraphy belonged to the practicable as distinguished from the practical period of its evolution; hence all systems other than those employing Hertzian waves will be excluded from this treatise.

A transmitter for the production and propagation of electric waves includes a source of current, means for interrupting a direct current (or an alternating current may be used), means for changing the interrupted or alternating current into low-frequency, high-potential currents, and means for transforming these into high-frequency, high-potential oscillations—such as are produced by the disruptive discharge of a Leyden jar through a circuit having a small resistance—and means for converting the oscillations into electric waves and emitting them; the receiver must provide means for intercepting the electric waves, and re-transforming them into electric oscillations, means for detecting minute differences of potential created by the enfeebled oscillations thus set up, and means for manifesting, either visually or audibly, these oscillatory hieroglyphics and translating them into readable Morse; besides other appliances having various special functions.

Without delving into the records of direct, alternating,



EXTERIOR OF WIRELESS-TELEGRAPH STATION AT CUXHAVEN, GERMANY, BRAUN SYSTEM.

and induced currents, the history of which is well-known, a mere retrospective glance at oscillatory currents—which play so important a *rôle* in wireless telegraphy—will suffice to illustrate the real beginning of the knowledge upon which the art is founded. Felix Savary, in 1827, postulated with marvelous accuracy the now accepted theory of the oscillatory nature of a disruptive discharge, showing that the charges of the inner and outer coatings of a condenser were not restored to zero potential by the mere single passage of current electricity in one direction, but that the equalization was due to several reflex actions—like the vibrations of a steel spring—before the electrical equilibrium was obtained. Joseph Henry in 1842 obtained experimental proof of this phenomenon by observing the changes of polarity in fine steel needles when magnetized by a frictional (plate-glass) electric machine at a distance. In 1847, Von Helmholtz published in his "Conservation of Energy" his deductions

relating to oscillatory currents, proving mathematically that the discharge of a Leyden jar is a "backward and forward motion until the entire *vis viva* is destroyed by the sum of the resistances." In 1852 these deductions were verified by Sir William Thomson, now Lord Kelvin, who worked out the theory on the experimental evidence of Faraday, who had obtained oxygen and hydrogen mixed at either pole. Lord Kelvin suggested a method by which the spark of a discharge could be segregated, by means of a Wheatstone revolving mirror, and in 1859 Fedderson adopted this means and succeeded in detecting a series of minute sparks and placing the work of those before him on a sound physical plane.

Through another of Faraday's classical experiments, James Clerk-Maxwell was led, in 1865, to evolve his electromagnetic theory of light which, simply stated, resolves all forms of transverse vibrations of the ether, or polarizations, into waves composed of magnetic whirls and electric displacements alternately; he determined mathematically that these polarizations were due to rapidly moving charges of electricity shearing the ether—as when an oscillatory current of a discharged Leyden jar traverses its circuit; likewise it was ascertained that the periodicity of oscillation depended on the size of the body in which the current surged; on a body of atomic size it would oscillate trillions of times per second, emitting visible waves, but on a sphere of say, a meter in diameter, electric waves nearly 150 centimeters in length will be emitted and though these latter waves are invisible to the eye, there are as truly electromagnetic in character as light waves. This was the mathematical theory of Maxwell, but like the deductions of Von Helmholtz it required verification by actual experiment. This was forthcoming in 1888, when Heinrich Hertz succeeded in producing electromagnetic waves (to which he subsequently gave the shorter name of electric waves) standing in free space and gliding over wires; he showed that they could be reflected, refracted, polarized, diffused, and generally followed optical laws just as though they were light waves. This achievement was the first real advance toward the art of wireless telegraphy.

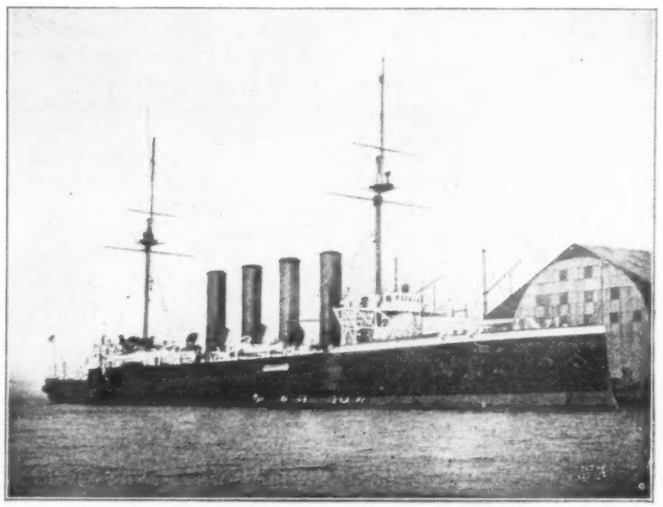
As a detector of electric waves at a distance from whence they were emitted, Hertz employed a circlet of wire having an air gap in it of microscopic size; this he termed a "resonator." The distance to which waves could be detected with it was very limited, but it served Hertz's purpose admirably. The next step toward electric-wave transmission without wires was made in 1890, when Edouard Branly, in a course of experiments showing the "variations of conductivity under electrical influence," found that metal filings placed in a tube having terminal conductor plugs was marvelously sensitive to feeble oscillations set up by impinging electric waves, and to this electric eye he gave the name of *"radio-conductor"*; Lodge renamed it *"coherer."*

The first apparatus having all the essentials of a modern wireless-telegraph receiver was designed by Prof. Popoff in 1895, but was employed by him as a meterological detector of distant storms, registering their presence by means of electric waves, emitted by the lightning, impinging on a vertical wire connected with the ground through a coherer. The first practical transmitter for wireless telegraphy was constructed by Marconi in 1896, when he added a vertical wire to one arm of an oscillator and grounded the opposite arm, making it the physical counterpart of his resonator, which was designed on the same general lines as the receiver of Popoff. This brings the history of the art to the time of its commercial solution. From this period to the present date, new workers, with one exception, have been responsible for the systems herein described. These systems have been designed not only to cover extreme distances, but also to render possible the selective interchange of messages, or syntonic wireless telegraphy.

Theoretical—The theory of the propagation of electric waves over long distances has been the subject of considerable recent discussion in the United States, but fortunately this phase of Maxwell's deductions does not enter into the practice of wireless-telegraph engineering to any great extent; a brief outline of the two principal conclusions which have been reached, and the solution of the acting referee, will serve, however, to show the trend of opinion upon this subject.

Any theory advanced must conform with Maxwell's conceptions and the experiments of Hertz, but as the fundamental equations by which Maxwell evolved his theory are as broad as they are beautiful, its interpretations by various technicians are widely divergent, and the final solution is rendered all the more difficult when Hertz's work is consulted; for he not only observed electric waves in free space, but waves which traverse the surface of wires as well.

The first of these theories is based on Hertz's experiments embodied in his paper "On the Propagation of Electric Waves by Means of Wires," in which he shows transverse electrical displacements, or sliding waves traveling over a conducting wire, may be produced; or, to quote Hertz's own words, "the electric force which determines the current is not propagated in the wire itself, but under all circumstances penetrates from without into the wire, and spreads into the metal with comparative slowness and according to laws similar to those which govern changes of temperature in a conducting body." This is due to the inductance, and when the frequency of the current is of the order of millions per second, by virtue of the opposition inductance offers to such high frequencies, the current must flow on the surface of the wire."



H. M. S. ABOUKIR, EQUIPPED WITH MARCONI APPARATUS.

On the assumption that the earth is a perfect conductor, Prof. Reginald Fessenden and others elucidate the theory of wireless transmission based on the postulate of semi-free and half waves. These are caused by the electric waves which stream from the antennae to the earth, and, striking it, are detached and the half waves skim over its surface as in the case of Hertz's experiment just cited. To complete this theory it is further assumed that the opposite arm of the oscillator—which is grounded—does not emit waves, and that the opposite half of the wave is mythical, like the reflection of an object in a mirror.

The second theory is that advanced by the author and others, and accounts for the rectilinear propagation of electric waves in accordance with Hertz's physical demonstration of Maxwell's electromagnetic theory of light. In his paper "On Electric Radiation," Hertz showed how free electric waves or transverse vibrations of the ether—identical

with light waves, but longer—may be made to follow all the known laws of light.

This theory is based on the assumption that electric oscillations, surging with high frequency through the oscillator system formed by the antennae and the earthed terminal, emit free electric waves which are propagated through space just as are light waves by the vibratory charge of electricity on gaseous atoms. Where the curvature of the earth intervenes, it is assumed the waves are reflected like the rays of the sun producing twilight and dawn.

As a balm to the contending parties in these opposition theories, Dr. Arthur E. Kennelly asserts that both are right, by showing how the emitted wave not only traverses space in the form of transverse vibrations, but that portion of it which comes in contact with the earth slides over it.

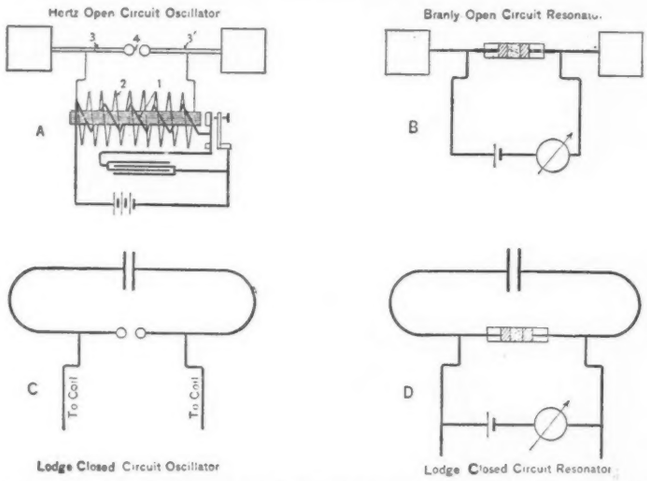


FIG. 1. DIAGRAM ILLUSTRATIVE OF APPARATUS FOR PRODUCING AND RECEIVING ELECTRIC WAVES.

The theory involving the method of producing and receiving electric waves is much more easily defined. The apparatus consists essentially of three electric circuits, shown in Fig. 1, A B C D; 1, A represents the inductor or primary winding of a Ruhmkorff coil, and 2 the secondary winding, in which low-frequency high-potential currents are set up; 3 3′ is the oscillator wherein the high-potential charge is transformed into electric oscillations of enormous frequency by means of the disruptive discharge taking place in the spark gap, 4. These three circuits may be regarded as entirely distinct and separate from the other, for, though the oscillator is connected directly to the terminals of the secondary, the latter is employed merely to charge the oscillator 3 3′ to a potential high enough to break down the air gap, 4; the great inductance of the secondary causes it to choke the oscillations, rendering the secondary impervious to it.

Again, the oscillator system may be of either the open-circuit type, Figure 1 A, or closed-circuit type, Figure 1 C. Lodge has shown that whereas the open-circuit oscillator is a most excellent emitter of waves, though these are damped out very rapidly, the function of the closed-circuit resonator is diametrically opposite, in that the oscillations are exceedingly persistent but are emitted very feebly. Therefore the open-circuit oscillator is pre-eminently the best adapted for long-distant transmission, whereas the closed circuit is at once commendable for resonance effects in syntonic systems. Likewise the resonator of the receiver may be of either the open or closed-circuit type, as shown in Figure 1, B and D.

The frequency of the oscillations in either case depends on the coefficients of the circuit; these are its inductance, capacity, and resistance. Inductance finds its analogue in mechanical inertia, for a current requires time for its acceleration in a conductor and time for its retardation. The capacity of an oscillator system is determined by the quantity of electricity required to raise its potential to the critical value where the charge will disrupt the air gap at 4, and depends not only on the dimensions of the oscillator, but the potential which is impressed upon it. The ohmic resistance of an oscillator is in reality exceedingly small, that is to say that it is *less* than the square root of the inductance divided by the capacity, and may be likened to the mechanical action of friction; therefore the current describes a curve that is periodic and alternate with maxima gradually decreasing in geometric progression; but if the resistance is imaginary —that is, if it is *greater* than the square root of the inductance divided by the capacity—there can be no oscillations and the current will be continuous and unidirectional.

In simple wireless telegraph systems these coefficients are of little importance; all that is needed is a good emitter, as the length of the wave may vary within wide limits without ill effects. But in syntonized systems they are at once mighty factors, for by adjusting their values the oscillator and resonator may be attuned or syntonized to each other as in acoustic resonance, the emitted waves of the former setting up counter-oscillations in the latter of identically the same frequency, while if waves are emitted by an oscillator having a periodicity different from that of the resonator there will be no response, since the effect of increasing the inductance and capacity of the circuits is to slow down the frequency of the currents, and in turn longer waves are emitted. Again, the frequency of the oscillations may be stepped-up or stepped-down by transformers, following exactly the same laws as alternating currents in general.

Practical—Based on the preceding theoretical deductions wireless telegraph apparatus may be divided into two general classes: (a) those constructed on non-syntonic lines, designed simply to cover long distances; and (b), those contrived to fulfill the laws of electrical resonance, or syntonic systems for individual selective telegraphy.

The first practical electric-wave system was, as a matter of evolution, of the non-syntonic class. In Figure 2, a diagram of the original Marconi transmitter and receiver is shown. By comparing it with the Hertz apparatus, Figure 1 A, it will be seen that the only difference lies in the extension of one of the oscillator arms forming the antenna and grounding the opposite arm. The Marconi receiver is similar to the one invented by Popoff, and is the counterpart of the transmitter in that the resonator consists of a vertical wire as well as an earthed terminal and connected in series with a coherer; the oscillator and resonator are therefore, of the open-circuit type.

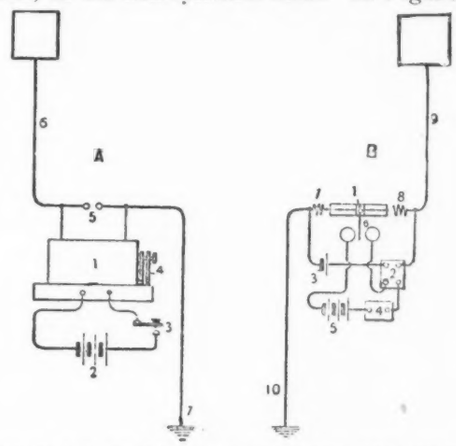


FIG. 2. DIAGRAM OF ORIGINAL MARCONI TRANSMITTER AND RECEIVER.

Referring to Figure 2, A; 1 represents an induction coil, 2 a source of current, 3 a key for arbitrarily making and breaking the current, 4 an automatic interrupter, 5 the spark gap of the oscillator, 6 the antennae, and 7 the earthed con-

nection: The component parts of the receiver are depicted at B; 1 shows the coherer, 2 a polarized relay operated by the single cell 3 in series with 1, 2; an auxiliary circuit includes the Morse register 4, the writing contacts of the relay 2, the battery 5, and the decohering tapper 6; two small inductance coils 7, 8, are interposed between the coherer and the relay to intercept the miniature trains of electric waves set up by the minute sparks taking place between the platinum points of the working contacts upon breaking the auxiliary circuit; the resonator is formed by the antenna 9, and the earthed terminal 10. By this apparatus Marconi sent signals in London in 1896 a distance of 300 feet, and by constantly improving the sensitiveness of the receiving devices,

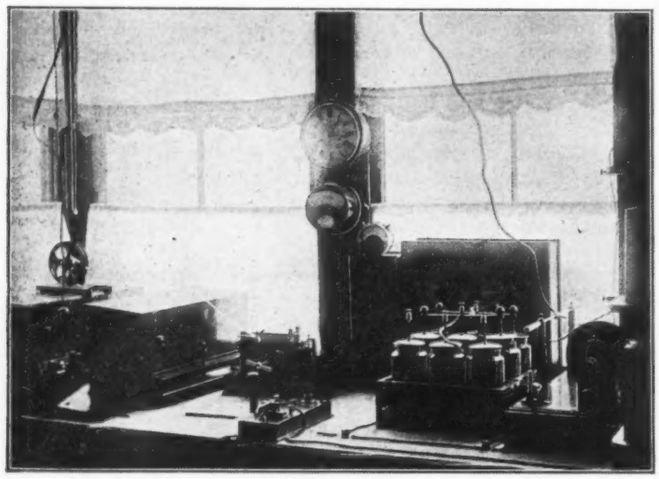


FIG. 3. INSTRUMENT ROOM, NORTH FORELAND STATION, MARCONI SYSTEM.

The station from which the earliest successful signaling across the English Channel was done.

by increasing the height and number of the antennae, and employing transmitters of greater power, he succeeded in transmitting readable messages a distance of nearly 2,000 miles in 1902.

The equipment of Marconi employed in the days of his earliest successes, when he telegraphed across the English Channel, is illustrated in Figure 3. The transmitter is shown to the extreme right and the receiver to the left; the coherer and all other parts of the apparatus sensitive to electric waves are placed in metal boxes, to exclude extraneous waves and prevent injury to the delicate adjustments when the powerful oscillations of the transmitter are taking place. The boxes are connected with the ground and all waves not received by the antennae are conducted to the earth and there dissipated.

But Marconi has been assiduous, not only in developing long-distance wireless transmission, but also in evolving a system which has for its object individual signalling; in this new apparatus the inventor has compounded the open and closed-circuit oscillators and resonators, and thereby obtained the maximum penetrative efficiency of the emitted waves, and retained at the same time the maximum persistency. This snytonic system is shown diagramatically in Figure 5; 1, 1′ represent two copper cylinders employed instead of the usual antennae in the transmitter and receiver. These are connected to earth at 3, 3′. Surrounding these cylinders are two metal cylinders of larger diameter, mounted in such a manner that an air space intervenes between them. In the transmitter (A) the outer cylinder is connected to one side of the spark gap 4, the opposite side terminating in the inner cylinder; 5 is a variable inductance; in the receiver (B) the two cylinders are connected through the primary by a small transformer coil 4′ and inductance coil 5′; the coherer 6 receives its impulses through the secondary of the transformer 7, the object of this arrangement being to allow the static differences of potential of the earth and outer cylinder to be equalized and not interfere with the coherer. The action of the instruments resembles that of two Leyden jars with closed circuits; when the disruptive discharge takes place in the air gap 4, the oscillations surge to and fro many times in the compound circuits before they die away; the waves emitted, though retaining somewhat the strength of those propagated by the open-circuit oscillator, form trains of waves, and these, impinging on the resonator circuit, set up oscillations which, though feeble at first, grow stronger through resonance until the potential difference impressed upon the terminal plugs of the coherer is raised to a value where it breaks down the minute insulating film of air separating the filings, and cohesion takes place. The local circuit containing the relay is attached to the terminals of the transformer coil 8, 9. Theoretically the values of inductance may be varied by the adjustable coils 5, 5′, and the capacity changed by increasing or diminishing the dimensions and therefore the capacity of the cylinders. Another advance toward syntonization is due to Marconi, who has devised a new magnetic electric-wave detector—that is to say, the coherer is supplanted by a detector based on a new principle. This detector is made by winding a layer of fine insulated

FIG. 4. MARCONI SHIP-SIGNALING STATION AT ROSSLARE, ON THE SOUTHEAST COAST OF IRELAND.

Showing mast and antennae leading to instrument room.

wire on a core of soft-iron wire; the terminals of this coil are connected with the antenna and earth respectively; over this is wound a second layer of the same sized wire, and these terminals are connected in series with a cell and telephone receiver. A magnet, operated by clockwork, revolves before the poles of the core and produces in its hysteresis by constantly increasing and decreasing magnetism, and by means of this cyclic change every oscillation set up in the primary coil by the impinging electric waves is marvelously accentuated. This detector is not only self-restoring, but its value in syntonic wireless telegraphy lies in the fact that its

resistance is practically constant, whilst the coherer is always variable.

A series of clever experiments were made in 1901 by M. Emile Guarini Foresio and his colleague, Artillery Lieutenant Poncelot of Brussels, Belgium, in repeating automatically wireless-telegraph messages. At Antwerp and at Brussels, 25 miles apart, two standard station installations were made, whilst at Mechlin, a village situated midway between the two cities, Guariani's automatic repeater was employed to relay the messages. In wireless telegraphy the antenna is cut off from the receiver when the transmitter is

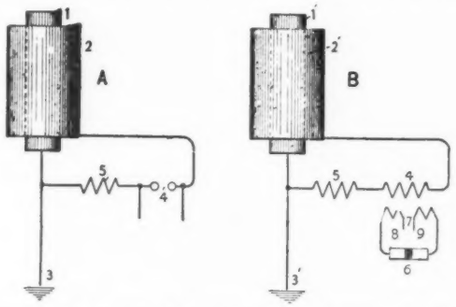


FIG. 5. DIAGRAM OF MARCONI SELECTIVE WIRELESS-TELEGRAPH SYSTEM.

in operation, and when messages are received this is reversed. It is evident that in a repeater this must be done automatically; the combination apparatus is shown diagramatically in Figure 6. Figure 8 shows photographically the method employed by Guarini for receiving the enfeebled waves and for all the subsequent translations from the coherer until the powerful re-energized waves are an instant later emitted from the same antenna.

A single antenna, 1, is connected to a relay, 2, of special

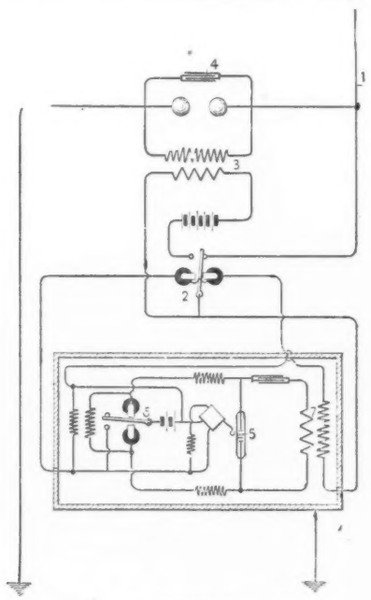


FIG. 6. GUARINI REPEATER.

1, antennae; 2, relay or aerial switch; 3, induction coil; 4, condenser, parallel to spark gap; 5, coherer; 6, relay; 7, transformer coil.

construction, termed an aerial switch, and having double contact points; when the armature of this relay is drawn to the right, the receiver is placed in electrical connection with the antenna, and when thrown to the left the induction coil, 3, is set in action; 4 represents a condenser in parallel with the spark gap. A regenerable Blondel coherer, 5, is in series with an exceedingly sensitive relay, 6, and these, with the necessary inductance coils, are included in a metal box as previously described. The primary of a small transformer, 7, is connected to the antenna and led to earth through the metal box; when the oscillations surge through the primary they are impressed upon the secondary of the coil, and this being in series with the coherer produces a potential difference in the latter which in turn causes the filings to cohere. The value of repeating wireless messages cannot be over-estimated, and it is only a question of time when the great trans-Atlantic service

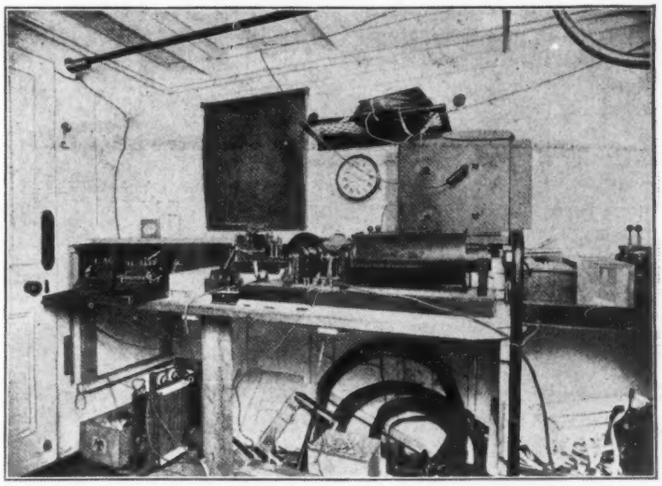


FIG. 7. MARCONI SELECTIVE WIRELESS-TELEGRAPH SYSTEM. STANDARD STATION SET ON S. S. PHILADELPHIA.

will be equipped with repeaters, enabling continuous communication to be kept up between England and the United States.

The Popoff-Ducretet apparatus is based upon a memoir presented at the Paris Congress of Electricity by Prof. M. A. Popoff and the observations of M. E. Ducretet. The transmitter is constructed on orthodox lines and is the result of a Ducretet's mechanical ability as an instrument maker. It consists of a regulation induction coil, an electromagnetic interrupter and oscillator of the Righi type, with the spark balls immersed in vaseline oil. The antenna is

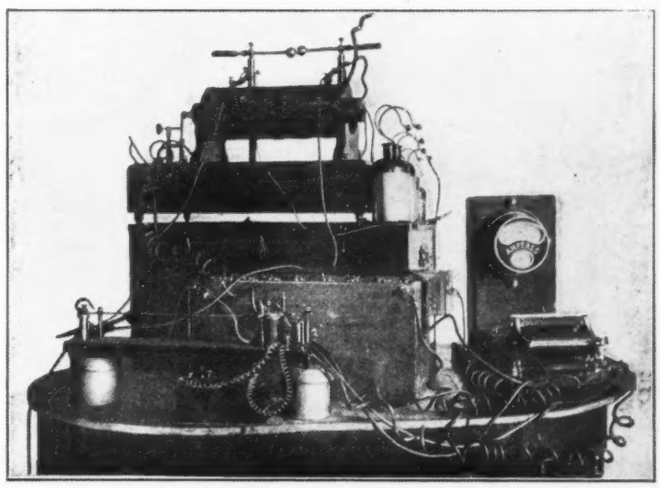


FIG. 8. GUARINI AUTOMATIC REPEATER.

connected direct to one side of the spark gap and the earth to the opposite side.

The receiver of Popoff differs from those described in that it employes a self-righting coherer; this type of coherer generally contains carbon granules instead of silver and nickel filings, and its normal resistivity is restored without tapping or other device to effect decohesion. In receiving

messages the antenna is connected to one of the conductor plugs of the coherer and the earth to the opposite one. The local circuit includes a single cell and a pair of head telephones, and the messages are read by the operator through the vibrations of the diaphragms of the telephone receivers, which respond to every change of the coherer. This type is much more sensitive than a metal-filings coherer and as the energy required to operate a telephone receiver is hundreds of times less than for the most sensitive relay, the Popoff instrument is extremely valuable for receiving messages at greater distances from the transmitter than is possible with the more complicated apparatus utilized in the standard station sets. The Ducretet transmitter is similar to Figure 2, A, and the Popoff receiver to Figure 1, B, except that in the latter the antenna and earth are connected to the coherer.

Senor Cervera, on behalf of the Spanish government, has designed a wireless-telegraph system that is, in some respects, different from those which preceded. While the transmitter of Cervera employs a vertical wire and grounded terminal of the open-circuit type, a condenser is inserted in either arm of the oscillator near the spark gap to increase the potential of the discharge. The receiver operates through the same antenna and ground wire as the emitter,

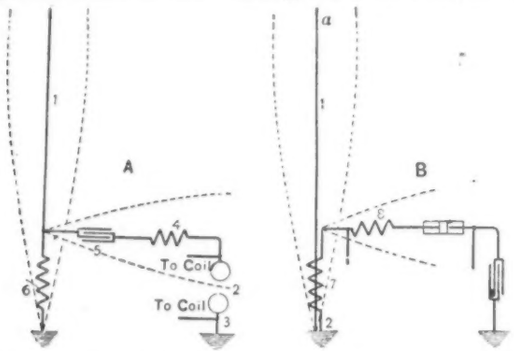


FIG. 10. DIAGRAMATIC VIEW OF SLABY-ARCO MULTIPLE-TUNED WIRELESS-TELEGRAPH TRANSMITTER AND RECEIVER.

but the changing switch is so arranged that the condensers are cut out when receiving. The distinguishing features of this apparatus are principally in the construction of the receiver. The antenna and earth are connected through the primary of a small transformer, the secondary of which is divided by cutting one convolution at the center and connecting the terminals thus formed to a condenser, and this in turn to the conductor plugs of the coherer.

The coherer consists of two small parallel ivory discs, adjusted by means of micrometer screws, and between them are the conductor plugs made of soft annealed iron forming the contacts with the powdered metal. There are four separate circuits in the Cervera receiving apparatus, each having its own source of current, and these fulfil the following functions—(a) operating the Morse register; (b) making and breaking the coherer and relay circuit, rendering decohesion more certain; (c) actuating the tapper; and (d) interrupting the circuit of an electromagnet regulating the sensibility of the coherer. The receiving circuits are more complicated than in any other system, but the apparatus works well and has given satisfaction between testing stations at Tarifa, Mount Comorro, and Ceuta at the Castle of Huelvo across the Strait of Gibraltar, a distance of 34 kilometers.

The Slaby-Arco multiple-tuned wireless-telegraph system is based on a number of original conclusions bearing on the laws of electrical resonance. Dr. Slaby and Count Arco begin by assuming that the height of the antenna should be one-fourth the length of the emitted wave, and instead of connecting the antenna to the side of the spark gap it is grounded direct as shown in Figure 10, A; a second conclusion is that the earth forms a nodal point for the current waves, and this being accepted it is plain that a second wire equal in length to the antenna and connected to it in the earth will respond to the current waves and a wave crest or its greatest amplitude at the end of the wire equal to that at the end of the antenna, as shown by the dotted lines.

The second or auxiliary wire does not need to be the same length, physically, as the antenna, but must represent the same inductance, capacity, and resistance; the spark gap, 2, of the induction coil is connected to one terminal of the

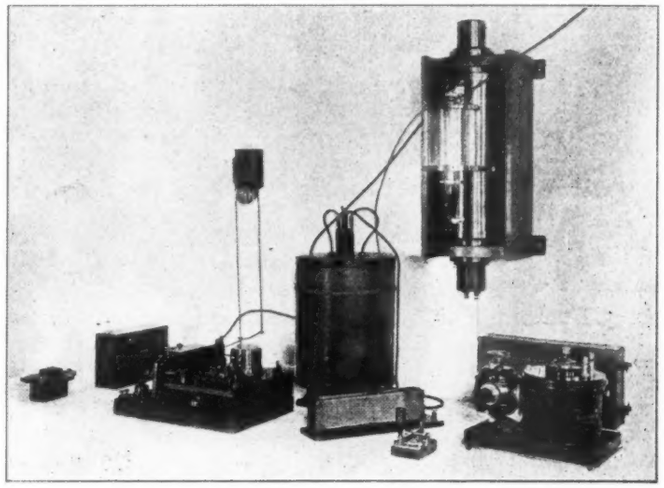


FIG. 11. SLABY-ARCO MULTIPLE-TUNED WIRELESS-TELEGRAPH APPARATUS. STANDARD STATION SET.

auxiliary wire and the opposite side grounded at 3; an inductance coil 4, and condenser, 5, both of which are adjustable, serve to make it of the same dimensions, electrically, as those of the antenna. The large inductance coil, 6, serves to regulate the fundamental harmonics of the open-circuit oscillator, 1. The resonator, B, is similar to the oscillator, A, and all waves not of predetermined length are dissipated in the earth, since the nodal point would not be at the juncture of the auxiliary wire; in the receiver this wire terminates in the coherer, the opposite conductor plug of which is earthed; the coils 7 and 8 are inductances for the purpose of tuning the system, which is compounded, embodying both the open and closed-circuit oscillators and resonators, but the dividing line between them is not very well defined.

In the photograph, Figure 11, a complete standard station set is shown; the induction coil with the oscillator, encased in a glass vessel filled with oil, is fastened to the wall; the primary current, supplied from 110-volt circuit, is passed through a mercury turbine interrupter operated by a small

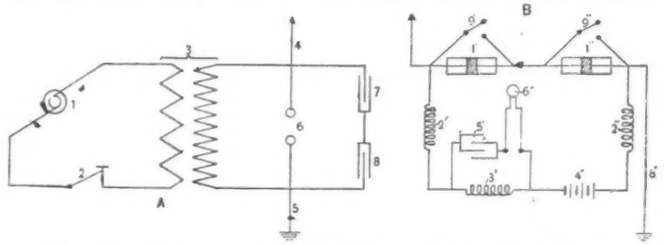


FIG. 12. DIAGRAM OF WIRELESS-TELEGRAPH SYSTEM.
A, transmitter; 1, alternating current generator; 2, key; 3, oil transformer; 4, antennae; 5, ground; 6, spark gap; 7, 8, condensers; B, receiver; 1′, 1″, responders; 2′, 2″, choke coils; 3′, resistance 5,000 ohms; 4′, battery; 5′, condenser; 6′, telephone receiver; 7′, antennae; 8′, ground; 9′, 9″, shunt switch.

motor, shown to the right; a key and variable resistance completes the transmitter. In practice the inductance coil (4, Figure 10) consists of a few turns of heavy wire wound on the outside of the condenser, 5, made up, in this case, of

a number of Leyden jars (Figure 11) enclosed in a cylindrical pasteboard box. A relay, coherer, tapper and Morse register form the principal elements of the receiver, whilst a bell, arranged in parallel with the Morse register, serves to call the operator. This system was exhibited before the German Emperor when two messages were received simultaneously from different stations.

The De Forest wireless telegraph is an American system designed by Dr. Lee De Forest and Prof. Clarence S. Freeman, and contains several novel features. The transmitter is widely different in its construction from those employing induction coils of the Ruhmkorff type, in that a 110-volt current is transformed by a rotary transformer into an alternating current at 500 volts and this is stepped-up in an oil transformer to 25,000 volts; a condenser formed by a number of Leyden jars is charged to their maximum capacity by this low-frequency high-potential current, and the high-frequency high-potential currents are obtained by the disruptive discharge of the jars through an oscillator having the usual air gap. Figure 12, A, shows the connections of the transmitter. The antenna is connected to one side of the oscillator and the earth to the opposite side. A key for breaking the primary circuit under oil has been designed especially for high-speed work. A photograph of the sending apparatus is shown in Figure 14.

The De Forest receiver employs a detector of the electric waves which responds to the impressed difference of potential in a manner similar to an anti-coherer, and diametrically opposite to that of an ordinary coherer; that is, it has its resistivity increased, but unlike the anti-coherer, the responderer of De Forest, has an internal action due to electrolysis. Unlike the receiver of Popoff-Ducretet, the circuit including the head telephones, responder, and cell of the De Forest receiver has a nominally closed local circuit, the current from the cell flowing through the telephones all the time the instrument is in operation. When the impining wave sets up its complementary oscillation, the latter acts upon the responder and instantly its resistance is increased, the local circuit is broken, and the diaphragm, released from the pull of the magnets, produces a sharp click. In Figure 12, B, it will be observed that the antenna and earth are connected to the primary of a small transformer and the responder, cell, and telephone, forming the local circuit, are connected in series with the secondary of the transformer. This system has been very successful and this is, no doubt, largely due to its simplicity of construction. At the Jersey City station on February 22, 1902, signals were received from the Etruria when the steamer was ninety miles at sea.

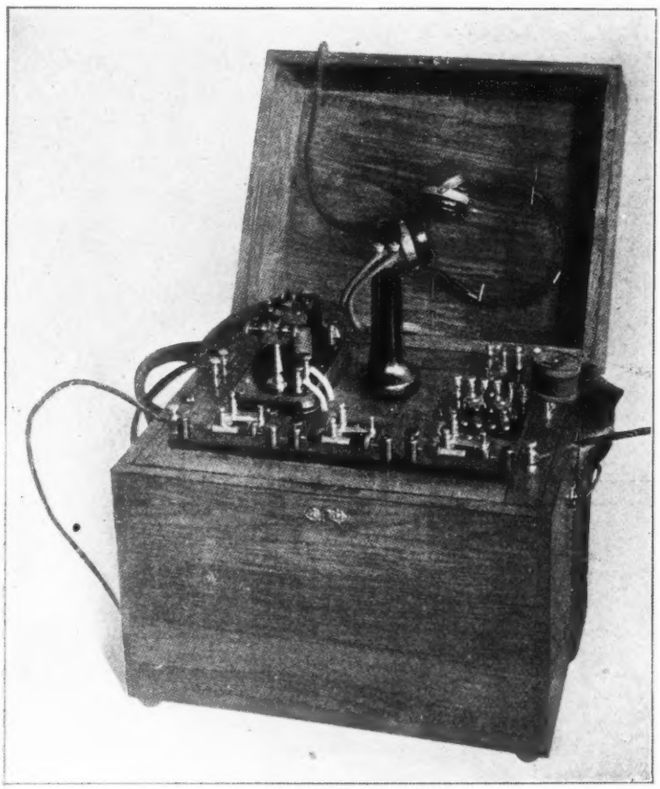


FIG. 13. DE FOREST WIRELESS-TELEGRAPH RECEIVER WITH TRIPLE RESPONDER AND HEAD TELEPHONES.

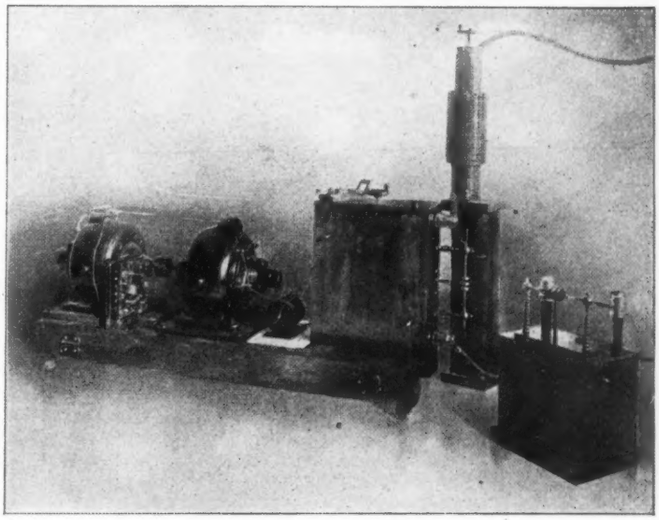


FIG. 14. DE FOREST WIRELESS-TELEGRAPH TRANSMITTER, Showing rotary transformer, oil transformer, condensers, spark gap, and key.

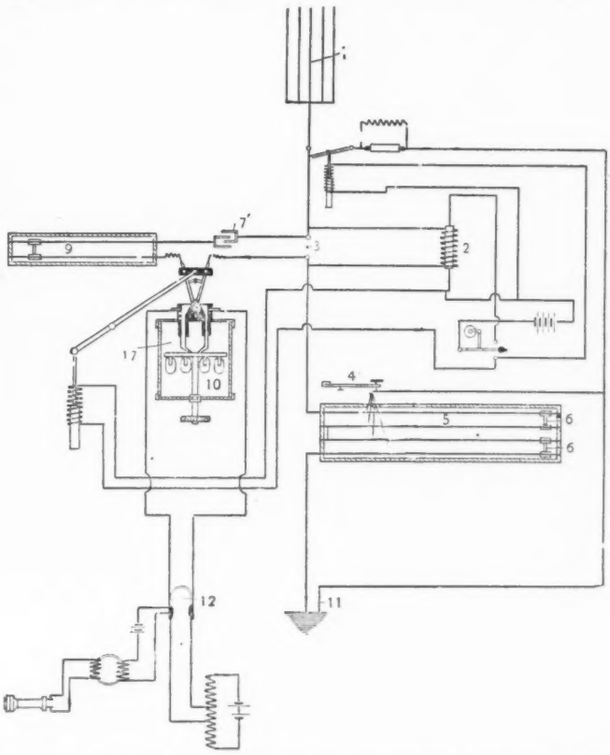


FIG. 15. FESSENDEN COMBINED SENDING AND RECEIVING APPARATUS.

In a series of patents issued to Prof. Reginald A. Fessenden, one of especial interest includes the principal features

of his improvements in wireless telegraphy. The diagram, Figure 15, shows a combined sending and receiving apparatus, 1 representing the antenna, 2 an induction-coil generator, 3 a spark gap, 4 a key to throw the antenna in and out of tune, the generator being kept continuously in action, 5 a tuning device or grid formed of one or more movable contacts, shown in 6 in electrical contact with each pair of wires; these are immersed in oil.

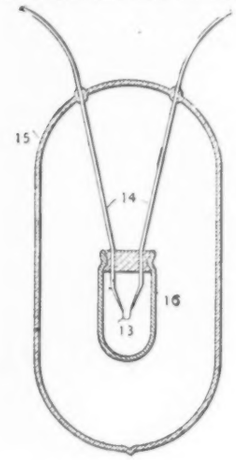


FIG. 16. FESSENDEN ELECTRIC-WAVE DETECTOR.

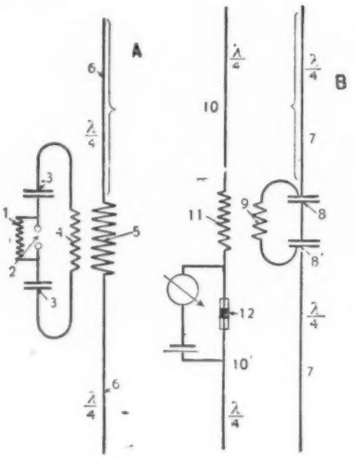


FIG. 18. SCHEMATIC ARRANGEMENT OF BRAUN'S WIRELESS-TELEGRAPH SYSTEM.
A, receiver; B, transmitter.

The tuning grid is novel in its construction in that it combines a variable inductance and capacity without resorting to coils, condensers, or capacity areas. By adjusting the capacity and inductance, a frequency of oscillation may be obtained which exactly corresponds to the natural period of the oscillator system—which includes the antenna—and a pure sine wave is the result.

The resonator of the receiver includes the antenna 1, the condenser 7, tuning grid 9, electro-magnetic-wave detector

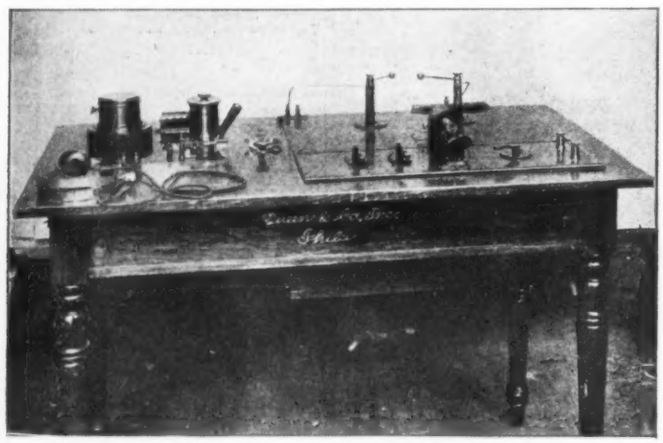


FIG. 17. RECEIVING AND TRANSMITTING APPARATUS, FESSENDEN WIRELESS-TELEGRAPH SYSTEM.

10, and the earth 11. The tuning grid is similar to the one employed in the oscillator system. That a high speed may be obtained in receiving, Fessenden employs a pair of head telephones 12, and the detector 10, which possesses decided advantages over an ordinary self-restoring coherer, not only in being more rapid in action, but in its economical function whereby all of the energy of the received wave is utilized.

The electric-wave detector, 10, is shown in detail in Figure 16; it is composed of a short loop of silver wire, 13, having a diameter of .002 inch, with a core of platinum wire .00006 inch in diameter and fastened to the leading-in wires, 14, these, in turn, being sealed in the glass bulb, 15. The tip of the silver loop is dissolved away by nitric acid, leaving the platinum exposed, and to decrease the loss by radiation the loop is enclosed in the silver shell, 16. The device shown at 17, Figure 15, is a holder for a number of the wave detectors just described. Figure 17 is a photograph of the Fessenden apparatus complete, the oil break of the key and nearly all the receiving apparatus being enclosed

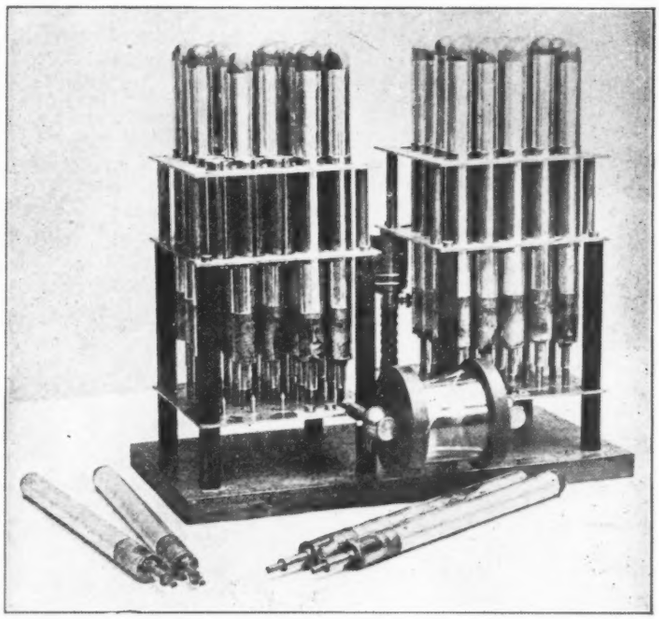


FIG. 19. BRAUN-SIEMENS & HALSKE VARIABLE-CAPACITY SPARK GAP FOR OSCILLATOR SYSTEM.

beneath the table. This system has been thoroughly tested by the U. S. Weather Bureau, of which Prof. Fessenden has been the wireless telegraph engineer for the past few years.

One of the best-known, though recent, systems, is that designed by Dr. F. Braun. The apparatus typifies the accrued knowledge of oscillations, electric waves, and resonance, combined with the most advanced mechanical ideas and the finest workmanship.

A diagramatic arrangement of the oscillator and resona-

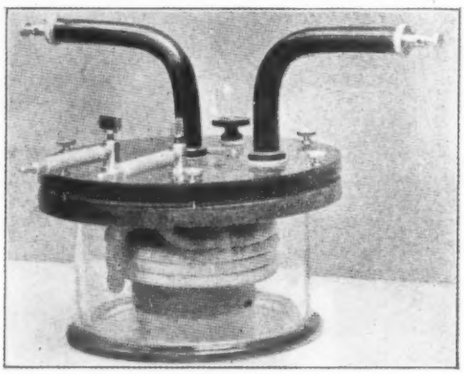


FIG. 20. BRAUN HIGH-TENSION TRANSFORMER FOR HIGH-FREQUENCY OSCILLATIONS.

tor systems is shown in Figure 18, A. B.; 1 represents the secondary winding of an induction coil, 2 the spark gap, 3, 3′ condensers, and 4 the primary of a high-tension transformer, the whole forming a closed circuit in which very persistent oscillations are produced; 5 is the secondary of the transformer, whose terminals are connected with two conductors 6, 6′, both of which are one-fourth the length of

the emitted wave, and forming an open-circuit oscillator system emitting powerful oscillations.

The receiver, B, consists of two vertical wires, 7, 7′, one of which is the antenna, both one-quarter the length of the received wave, and forming a closed-circuit resonator through the condensers, 8, 8′, and the primary winding of the transformer, 9; two auxiliary wires, 10, 10′, having the

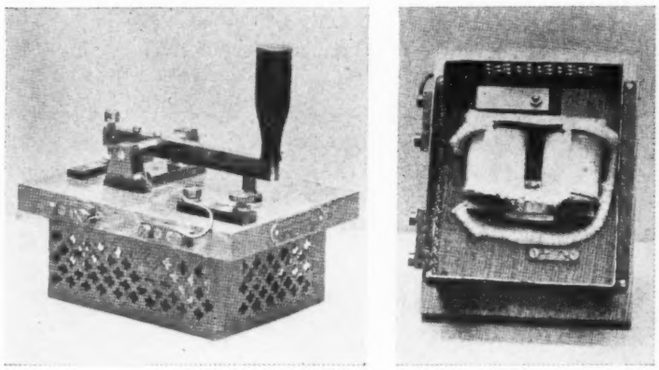


FIG. 21. THE FIGURE ON THE LEFT (A) SHOWS THE BRAUN KEY FOR BREAKING HEAVY CURRENT. THAT ON THE RIGHT (B) GIVES THE UNDERNEATH VIEW OF THE KEY, SHOWING THE MAGNETIC BLOW-OUT.

same length as 7, 7′, are connected to the terminals of the secondary of the transformer, 11; in one of the wires a coherer, 12, is included and from this local circuit is derived. This is the only practical system in which the earth is eliminated as a factor for tuning, capacity areas in the form of concentric cylinders being employed instead, and these make syntonic wireless telegraphy a practical fact instead of a theoretical fancy.

When in action the apparatus performs the following functions; the secondary of the induction coil charges the closed oscillator circuit after each disruptive discharge takes place, and the persistent oscillations thus set up are transformed into any frequency desired in the open-circuit oscillator, from which the waves are emitted very freely; the waves impinging on the closed-circuit resonator produce

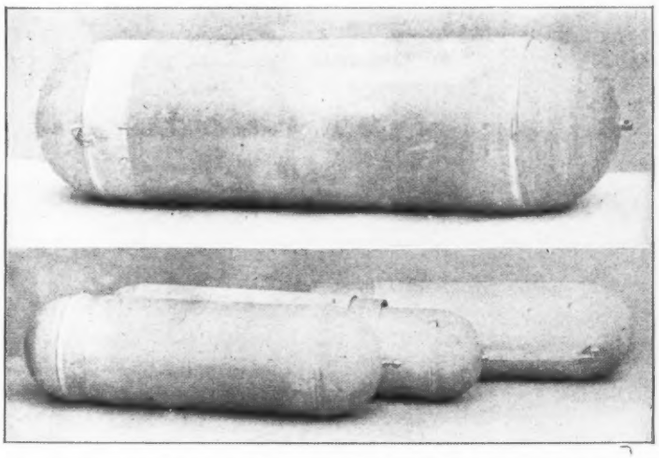


FIG. 22. CAPACITY AREAS, BRAUN-SIEMENS & HALSKE SYSTEM.

One arm of the oscillator and resonantor is connected with these instead of being grounded in the usual way.

counter-oscillations of fundamental frequency, and these are transformed into the open-circuit, where their amplitude becomes greatest, and produce the difference of potential necessary to act on the coherer.

The accompanying photographs of the Braun system illustrate the apparatus for producing these effects. Referring to the diagram the condensers 3 3′ are arranged on a stand (Figure 19) and consist of a series of miniature Leyden jars; by this arrangement an adjustable capacity is pro-

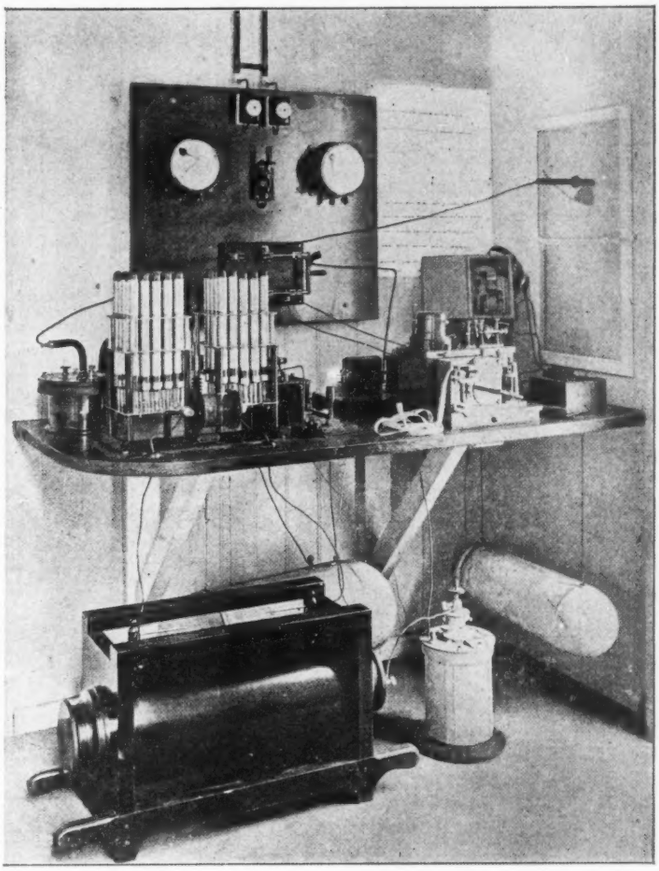


FIG. 23. BRAUN-SIEMENS & HALSKE WIRELESS-TELEGRAPH EQUIPMENT. STANDARD STATION APPARATUS.

duced; the spark gap, 2, is formed between two metal balls immersed in oil contained in the glass cylinder attached to the front of the condensers.

In Figure 21, a, b, are two views of the Morse key de-

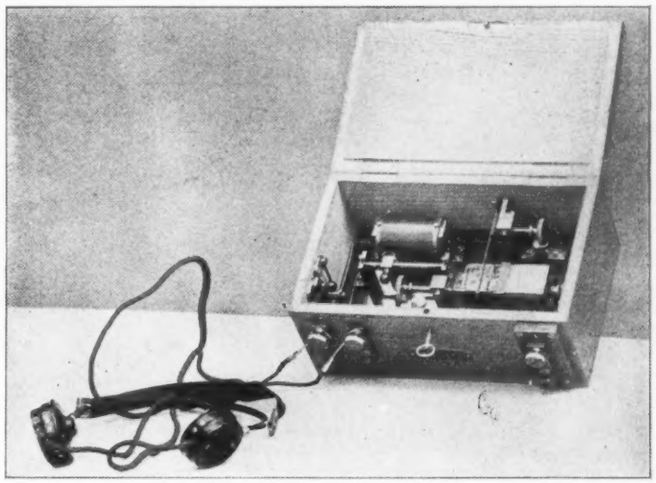


FIG. 24. THE BRAUN FIELD RECEIVER.

signed for breaking heavy currents, the spark of the break due to heavy currents being eliminated by the magnetic blowout shown in b. The high-tension transformer appears in Figure 20; this gives clearly the construction of this

simple but highly ingenious piece of apparatus for stepping-up oscillatory currents as depicted diagramatically at 4, 5, Figure 17. The jar of the transformer contains oil when the coil is in action.

The capacities employed to take the place of the earth depicted in Figure 22 are made of copper or zinc, usually of

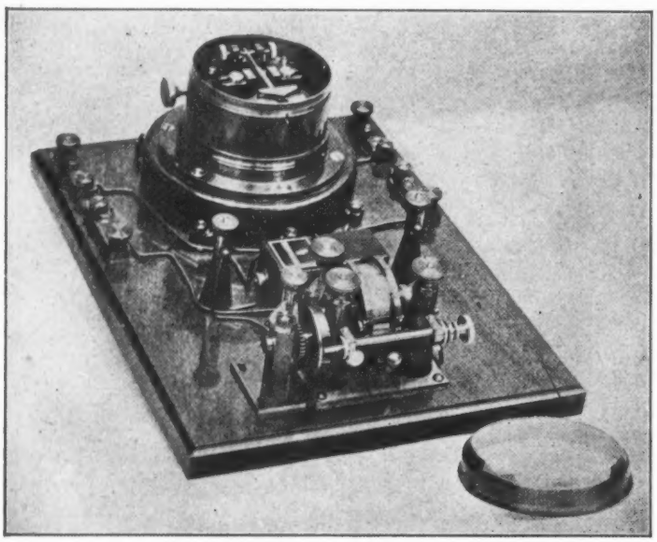


FIG. 25. BRAUN-SIEMENS & HALSKE POLARIZED RELAY ELECTRO-MECHANICAL TAPPER AND COHERER.

two parts, sliding within each other, thus offering a variable capacity. The complete sending and receiving system for a standard station is shown set up for testing prior to shipment in Figure 23, and the connections are so clearly defined they may be followed almost as easily as in a diagram. The induction coil with its accompanying electrolytic interrupter —on the floor—is operated by 110-volt current leading in to the switchboard. The secondary is connected directly to the spark gap. The large switch is for the purpose of cutting in and out the antenna from the transmitter and receiver. The small transformer for the receiver, the relay, mechanical tapper, coherer, and Morse register complete

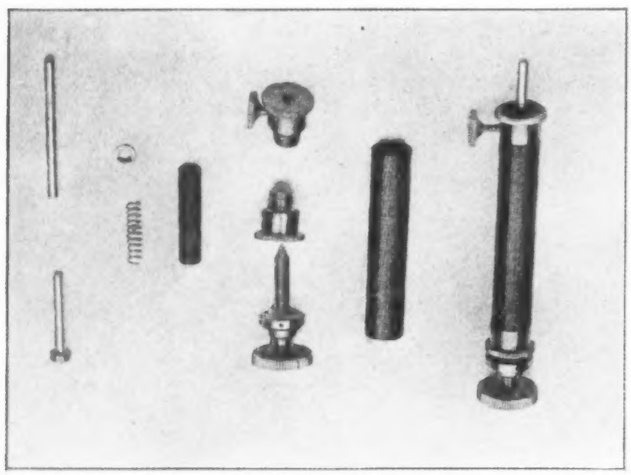


FIG. 26. THE BRAUN COHERER AND ITS COMPONENT PARTS.

the equipment. Braun's system has met with flattering success between Helgoland in the German Ocean and Cuxhaven, a distance of 36 miles.

This represents the state of the art and the practice of signaling through space without wires to the present time. In conclusion, it is interesting to note that the letter "S" was sent and received across the Atlantic Ocean wirelessly, and that messages have been transmitted and recorded between two stations, which could not be received, intercepted or annihilated by a third station; at present the difficulties in the commercial use of such long-distance transmission and syntonic systems are many; but it portrays with vividness the ultimate scope wireless telegraphy will have in the transmission of the world's intelligence in the very near future.—*Engineering Magazine.*

A MORAL TO BE INFERRED.

The troubles and mistakes caused by party line telephones are many and sometimes, humorous. As an illustration of an every day occurrence is the following relation of what happened to a young business man of Peru a few days ago. Wishing to converse with a Water street business man, and not having time to go to see him, he decided to use the telephone. On being connected with the number requested he was informed that the man he wished to talk with was at his home. He then rang up the man's residence, and for some unaccountable reason the telephone girl connected him with the wrong number, another telephone on the same line. He was answered by a young lady who gave him her number but refused to tell her name. Neither party became angry at the mistake of the telephone girl, but instead became engaged in conversation. They became desperately interested in each other and before hanging up the receivers an engagement was made for the same evening. As neither party knew who the other was they agreed to wear a carnation and meet at a certain corner at 8 o'clock.

The young lady was the first to appear at the appointed spot and her telephone friend came around the corner shortly afterward. He had left home about five minutes previous, telling his wife that he was going to a lodge meeting. When he met the young lady his expectations of a pleasant evening in her company were ruthlessly shattered when, at the appointed corner, he met his wife's sister.

TELEPHONE LANGUAGE.

The rulings on the subject of pouring strong language into the receiver of your telephone confirm the illegality of the procedure. A St. Louis justice some weeks ago held that it is aggressive profanity. A Chicago justice has added to that dictum with the assertion that profanity of that description is disorderly conduct. Hence the exasperated person who has wasted some 25 minutes in the attempt to get a connection with No. 1313 North-northeast will do well to bear in mind that strong language is under the ban. If he desires to relieve his feeling he should hang up the receiver and go over to the farthest corner of the room before whispering his comments to himself.

It is observed that these restraints of the law are solely for the protection of "Central." Nobody ever does swear at the person he desires to talk to. If he successfully passes through the ordeal and gets the number he is after the effect is so beatific that all further remarks are in the happiest vein. The inhibition of strong language being to guard the sensibilities of "Central" against shock does not the judicial definition contain a corollary essential, though not yet directly pronounced? Given that interjecting a lurid phrase into the receiver is disorderly conduct does not a legal duty of "Central" follow—not to indulge in conduct calculated to provoke a breach of the peace? If it is understood both that the subscriber must not swear and that "Central" must not keep him supplicating for a number for ten minutes before pronouncing that damnatory "Busy!" the strains of telephonic communication may be materially lessened.

EQUIPMENT OF A MODERN TELEPHONE EXCHANGE.

F. A. S. WORMULL.

CONCLUDED.

The relays are fixed on an iron frame in the same room, arranged in bays and in rows of ten, the line and cut-off relays being fitted on the same base plates. These are arranged in the same order as the vertical tabs on the distribution frame—viz., in the order of the home section jacks on the operators' positions. I have a sample of the line and cut-off relays here, but perhaps they deserve a short description.

The relay consists of a single coil wound to a resistance of 83 ohms, and in front of the free end of which is a disc armature, turned to a knife edge and balanced in a slot in a piece of iron, which forms an extension to the pole of the relay nearest the base plate, the disc being controlled by a regulating screw through the center. In the front of the relay a contact point is provided, to which the calling lamp is connected, and in such a position as when the armature

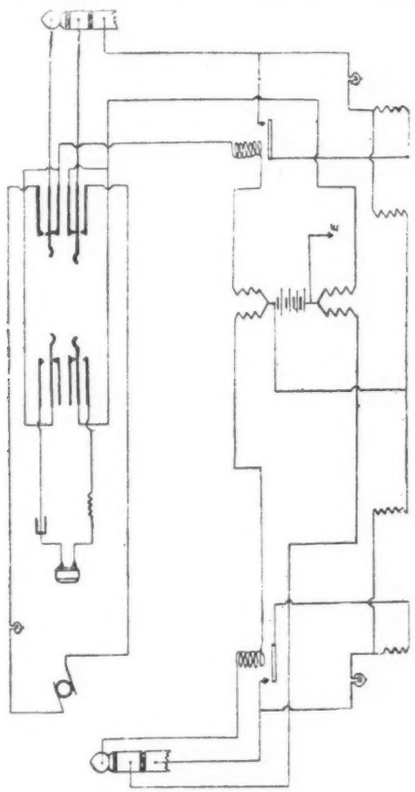


DIAGRAM 8.

is attracted a circuit is formed through the disc armature and the contact point referred to.

The cut-off relay is slightly more complicated. It consists of an electro-magnet wound to a resistance of 37 ohms. The pole piece of the free end of the magnet is extended and bent at right angles, so as to be parallel with the core and overlapping the outside of the bobbin. A flat armature is supported on a pole piece fixed to the base plate end of the magnet. Parallel with the armature four spring contacts are fixed normally in contact in pairs. The outer springs are controlled by insulated studs on the armature, so that when the relay is energized the two pairs of springs are lifted apart and the line signal circuit broken.

The repeater coil, which is placed between the battery and the connecting cords of the operator's set, consists of four coils of equal resistance (37 ohms) wound in pairs round an iron core, the two coils to the positive side of the battery to which the tips of the cords are connected being wound on the right-hand side of the core, as shown on Diagram 8 and the two negative coils, or those connected to the rings, on the left. The two wires of each pair, being wound on together, are equal in the number of turns, and also equidistant from the core. The object of this repeater is to divide the cord circuit into two parts for signalling purpose without interfering with the efficiency of the speaking circuit. The 63-wire cable from the horizontal side of the distribution frame is carried through multiple of the switchboard, first to the jacks on the junction section, then on to the subscribers' sections, in a manner similar to that described in the series system. The jacks, however, in this system differ from those previously described, the lines being carried through the board in parallel, so that the insertion of a plug in the first jack of the multiple will not disconnect the remainder of the board. The advantage claimed for the parallel jacks over the series jacks is that the number of loose contacts in the circuit is reduced. The test circuit in this pattern jack, as in the former, is completely insulated from the line springs and extended so as to pass through the winding of the cut-off relay. The home section jacks and lamps are arranged in groups of 100, each group forming an operator's position, and immediately in front of which the operator's connecting cords and supervisory lamps are placed. The operator's set and connecting cord circuits are very much more complicated in this system than in either of those previously described. Three-point plugs are used in conjunction with repeating coil and relays for controlling the clearing lamps.

The connecting-cord circuit is as follows: From the tip of the answering plug connection is taken through the coil of the relay controlling the supervisory or clearing lamp of the answering plug, through one-half of the repeater coil to the relay controlling the clearing lamp of the calling plug, thence through the listening key to tip of calling plug, from the rings of the answering plug through the other half of the repeating coil, through listening key back to ring of calling plug, from the body of the answering plug through the answering plug clearing lamp, to an 83-ohm simple resistance coil, thence to negative side of battery; from the body of the calling plug, through the calling plug clearing lamp, through 83-ohm coil to battery. There is an alternative path from the current from the battery to body of plugs through a 40-ohm simple resistance, this path being controlled by the armature of the supervisory relays.

In order that the calling circuit may be followed a short description of the subscribers' instruments must be given. These consist of a specially wound induction coil, having a ratio of 1 to 2, transmitter, receiver, switch hook, magneto bell and a two-microfarad condenser, joined up as shown in Diagram 9. It will be seen that when the receiver is on the hook the circuit is open as far as continuous currents are concerned, but a circuit is available for alternating currents through the condenser and magneto bell. When the receiver is off the hook the two lines are short-circuited through the 15-ohm primary and transmitter.

A subscriber's calling circuit is as follows: From the "A" line through cut-off springs on the cut-off relay, to

winding of signal relay, to negative side of battery. From the "B" wire to cut-off springs on cut-out relay to positive side of the battery. A subscriber removing his telephone from the hook closes the circuit through the low resistance of his primary, thus energizing the signal relay, which closes the local circuit in which his signal lamp is connected, indicating to the operator that he requires attention. On the operator inserting the answering plug the cut-off relay is

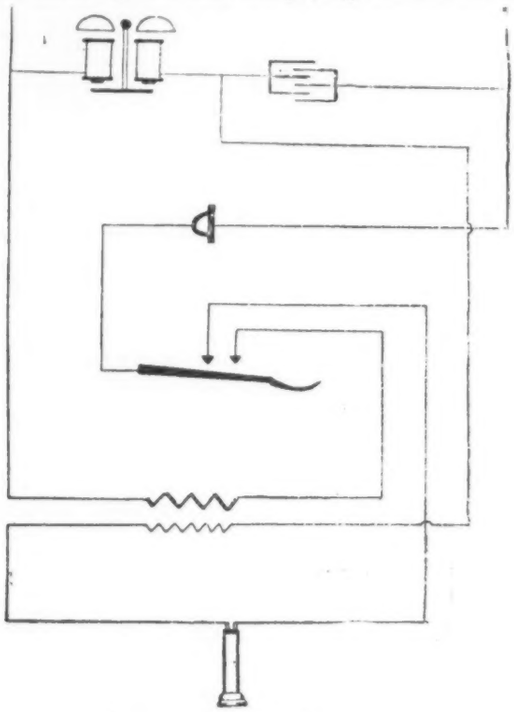


DIAGRAM 9.

energized by the current from the body of the plug, passing through ring of calling jack, through the winding of cut-off relay, to positive side of battery. The lifting of the armature of the cut-off relay forces the cut-off springs apart, thus breaking the circuit between the subscriber's line and called wanted being ascertained, the operator takes the corresponding calling plug and taps on to the ring of the jack of the number asked for, and if the receiver remains silent inserts the plug. The current on the body of the calling plug causes the supervisory lamp to light, which remains alight until the wanted subscriber removes his telephone from the hook. The supervisory lamp of the calling plug is extinguished when the supervisory relay becomes energized by the current drawn from the battery through the ring of the plug, through the primary of the subscriber's instrument, back to the tip of the plug and battery. This shunts the current from the supervisory lamp through the alternative path before mentioned; or, in other words, the insertion of the answering plug cuts the line relay out of circuit and inserts the supervisory relay for the reception of any subsequent signal from the calling subscriber. The insertion of the calling plug cuts the circuit of the line relay of the wanted subscriber, thus preventing a call being given on the home section lamp, when he removes the receiver from the hook to reply to the call. The supervisory lamp of the cord circuit now becomes his means of signalling with the exchange. On a connection being completed and both supervisory lamps extinguished, the operator knows that the two subscribers are in communication; the hanging up of either of the subscribers' receivers will cause the lamps to light, and when both lamps are alight the operator knows that the conversation is completed and proceeds to withdraw both plugs without challenging the line, which restores the line calling relays to their normal position.

The number of movements to effect a connection in this system is four—viz., (1) insert plug and answer; (2) insert corresponding plug in number wanted; (3) ring subscriber wanted; (4) replace listening key; and for a disconnection, two: (1) pull out plugs; (2) pull over listening key.

The current for working this system, although normally taken from a set of 11-cell accumulators, is actually, during the busy hours of the day, taken direct from a specially wound dynamo, with the accumulators bridged across the discharge mains, the unutilized current from the dynamo being absorbed by the cells. The dynamo is a six-pole shunt-wound machine, driven at 1,100 revolutions per minute, capable of giving a current of 200 amperes at 30 volts, and is coupled direct to a 12-h. p. four-pole shunt-wound motor, running off the town mains.

In this system it is not essential that a duplicate battery should be provided, but duplicate motor-generators are

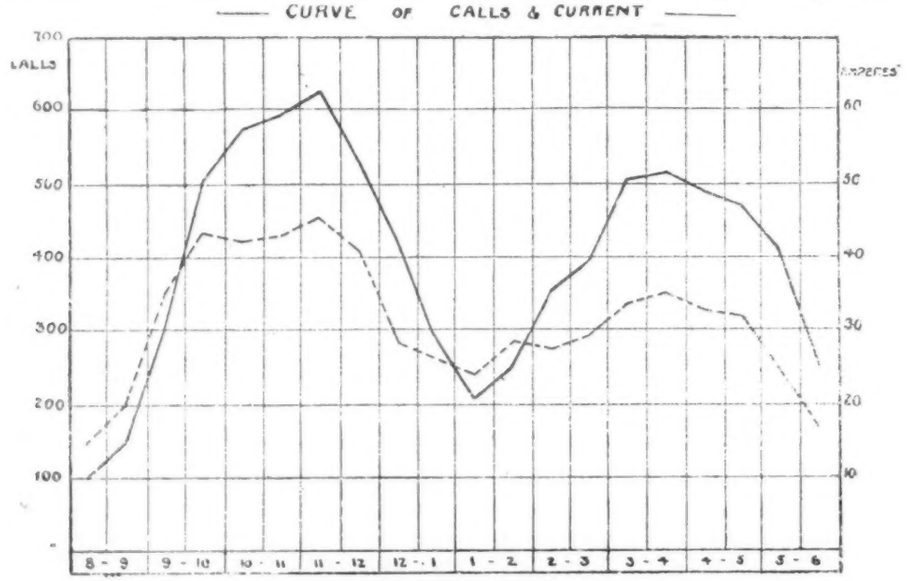


DIAGRAM 10.

necessary in order to avoid a breakdown. This system, as previously mentioned, works equally well without the accumulators being bridged across the discharge mains, but in order to work economically and avoid the necessity of running the machines during the quiet hours the accumu-

lators are provided so that they may be switched into circuit to replace the dynamo when the current curve falls to a low figure. The power circuits do not call for any special description; the leads from the machines are carried to the power switchboard, fitted with the necessary starting and controlling switches, a voltmeter for taking the condition of each cell and the ammeters to the various discharge 'bus bars, so that the inspector in charge may keep a record of the current taken by the various circuits. From the power switchboard discharge mains are led to main fuse board, from which the various circuits of the switchboard are fed through suitable fuses. A main is also taken to the 'bus bars of the coil and relay rack fuse board, supplying the current to line relays and repeater coils. Diagram 10 is a curve of calls and current, the figures on the left being the number of calls in hundreds, those on the right the number of amperes, and the vertical lines the half-hours of the day. The black line is the curve of calls taken in half-hours and the dotted line the amperes over a similar period.

THE TELEPHONE STATUS QUO*

ARTHUR VAUGHN ABBOTT.

It is difficult to estimate the present telephonic situation without the recitation of a little history that may appear quite trite to many.

The introduction of the telephone dates from 1876, when, at the Centennial Exposition, the Bell magneto instrument was publicly exhibited. Almost immediately the patents covering this, and subsequent kindred inventions, afterwards construed to cover all feasible methods for the electrical transmission of speech, passed under the control of an association, that under one corporate name or another, and in combination with its various operating and manufacturing affiliations, has been popularly collectively known as the Bell Telephone Company. The method of developing telephonic business consisted in forming a manufacturing company whose office was that of creating the necessary apparatus, and a large number of operating companies, one in each particular territory, to absorb and use, under license, this apparatus in serving the public. In all the subsidiary companies the parent organization took an active part, always retaining a controlling interest, so that the entire telephonic business of this country was, during the lifetime of the fundamental patents, to all intents and purposes, that of a single management.

The inception and perpetuation of an enterprise to operate over this entire continent necessitating business relations of the most heterogeneous character, required the exhibition of the keenest skill and shrewdness in the manipulation of men, and possessed the greatest advantages in uniformity, strength and coherence. Quite possibly, under any other form of organization, American telephonic development would be far behind what it is to-day, for it cannot for a moment be denied that the Bell system is a most magnificent masterpiece, both of business and technical engineering.

But with all these virtues some faults appeared. Seemingly a policy of secrecy prevailed. Telephonic conventions, initiated in the earlier days, were abandoned, or held at the rarest intervals; that freedom of speech so dear to the American mind, the exercise of which developed the later invention of the electric light and the electric railway, in a shorter period of time to a wider degree, was frowned upon even to the extent of non-technical publications. For the writer well remembers, after a popular magazine article, his general manager intimating that good telephonists should, like small boys, be seen and not heard. Search as one may, where in our transactions will one find a paper from a professional telephonist, save Mr. Carty's classic and ancient (though classic in spite of its age) exposition of electrostatic induction? The manufacture of apparatus, particularly of transmitters and receivers, was sedulously guarded and the magneto bell, the receiver and solid back transmitter stand to-day, after one and two decades of experience, unchanged and unimproved.

Nor was technical reticence and consequently impeded progress the only consequence. Gradually, in the public mind, arose an undefined feeling that something was wrong with the telephonic *quid pro quo*. Alleged extortionate charges, coupled with complaints of poor service, were whispered about. Legislative and aldermanic investigating committees were appointed, that resembled the fabled characteristics of the month of March, for they went to work like lions, only in due process of time to subside into the most lamb-like serenity. People saw only an insignificant bit of apparatus which their common sense told them could be made for a dozen dollars, for the annual use of which a charge of $50 to $250 was made. Small wonder, then, in view of this insufficient evidence, that on the expiration of the fundamental patents, there were hosts of enterprising electricians (many of them of the locksmith and bell hanger type) who were ready to flood the market with telephonic apparatus of all kinds, good, bad and indifferent; nor that there was a public trained and educated to embrace any telephonic relief from the real or fancied oppression of a so-called grasping monopoly. It is no part of the present paper to examine into the validity of the ground for this state of public sentiment. But it exists, deeply and strongly rooted in the public mind, fixed therein by nearly a score of years of most unfortunate training; so firmly seated that in some cases Independent exchanges, charging regular rates, have flourished and grown fat in the face of absolutely free service offered by the older company, in the hopes of crushing by superior endurance of a powerful backing, their younger and seemingly weak rivals. So strong is this sentiment that to-day, though the Bell companies are nearly a quarter of a century old, and the Independent companies barely six years, the field is quite evenly divided between them as shown by the statistics in Table I:

TABLE I.

	Bell.	Independent.
Invested capital.....	$320,000,000	$150,000,000
Number of exchanges.....	1,500	2,811
Sub-stations	1,080,000	1,198,000

During the past year about $18,750,000 has been spent on telephone apparatus, of which about 40 per cent is credited to the Independent interests, and in this field 415 new Independent telephone companies have been floated.

So far as apparatus is involved, there are to-day a number of firms that can, and regularly do, produce transmitters and receivers whose clearness and volume of articulation cannot for a moment be considered to be inferior to those manufactured by the older corporation. There are at least two companies that are prepared to, and do, manufacture as broad and variegated a line of switchboard apparatus, are well equipped, do as good work, attain similar results, and are supplied with electrical talent equal to that of the Bell company. So, it is possible to-day for any one to build a first-class telephone exchange, and with good care, shrewd and

*Paper read at the meeting of the American Institute of Electrical Engineers.

expert management, to give service that cannot be excelled, at the lowest possible price. Such, I say, is possible, but, unfortunately, it is rarely done. On the contrary, a very erroneous idea prevails in the minds of most of the Independent companies as to the requirements and limitations of telephony. A large portion of those interested therein seem to have been bitten by a kind of telephonic tarantula until they feel that a telephone exchange is a sort of Golconda. Put it in and it will run itself, rolling in dividends in a way to make the goose which laid the golden egg blush for incapacity. According to their doctrine, all one has to do is to put in a telephone (any kind of a telephone), build a line (any kind of a line), set up a switchboard (any kind of a switchboard), go away and leave it to its own devices, returning once a year to collect the dividends. For instance, the general manager of a 5,000-line Independent exchange recently remarked in answer to a question as to cost of maintenance, "Why, we don't have any maintenance; we have a new plant." And another gentleman, president of more than one telephone company, laughed me to scorn when I advised him to allow $2 per sub-station per year for maintenance expense, averring that 10 cents per year was amply sufficient for the purpose.

Another and more vicious result of such erroneous misconception is the way some new telephone companies are floated. Half a dozen of the prominent citizens of some town conceive the idea of a telephone exchange; an ordinance is rushed through the city council of which one or more of the "prominent citizens" are members, a company is formed; enough stock subscription raised to pay current office expenses, and the labor of erecting a few miles of wire. The switchboard and a lot of material is purchased on three months, six months or a year's time, a few subscribers connected up, and, lo! a full-fledged telephone plant is in existence, which the incorporators now proceed to mortgage to some confiding trust company, using a good block of stock as tempting bonus, securing to themselves a nice profit, and incidentally getting funds to pay for the switchboard and other material previously purchased on credit. How mistaken are these ideas the first financial cold breeze that blows over the country will surely demonstrate.

Such a condition of affairs is partly due to unprecedented prosperity in America, but it must not be forgotten that both prosperity and poverty progress in cycles. We are now about at the crest of the present prosperity wave, and in the flush of plenty and success men grow careless and plunge widely into all sorts of enterprises. I do not believe that 1 per cent of the population of Manhattan have ever seen a switchboard, or that one-tenth per cent have the slightest conception of the maze of circuits that traverse the streets. How many of us, electrical engineers though we are, and so presumably familiar with at least the rudiments of telephony, know anything of the tortuous path traversed by the messages we send a dozen times a day from our desks? By the formerly universal flat rate system a certain charge per annum was made for each rate system, and this method indissolubly linked the telephone instrument with the price charged. This is a false unit, and the erroneous impression thus created in the public mind will take years of sorrowful and patient eradication. It is not the instrument, but telephonic service that the subscribers pay for; not the transmitter and receiver that stand on the desk only, but the conduits, cables, switchboard, trunk line plant, the operators who patiently, night and day, await an instantaneous sum-

TABLE II.—GENERAL TELEPHONE STATISTICS.

	Name of City.	Population	No. of Telephones	Per cent of Telephones	WIRE MILES. Underground.	Aerial.	Total	Per Telephone	TARIFF. Flat Rates. Business Telephones. 1 Party	2 Party	4 Party	Multi Party	Residence Telephones. 1 Party	2 Party	4 Party	Multi Party
									$	$	$	$	$	$	$	$
B	Baltimore	507,000	6,300	1.25					125	100			100	78	60	
I	"	"	6,000	1.25	1,140	757	1,897	.3	48	42	32		30	30	24	
B	Boston	560,892	23,106	4.1	47,000	7,400	54,400	2.3	162	141			116	102		
B	Buffalo	352,219	9,449	2.7	6,830	5,475	12,305	1.3								
B	Chicago	1,698,575	37,960	2.2	108,633	33,190	141,823	3.8	175				100	75	60	
B	Cleveland	381,000	13,744	3.5	28,623	13,119	41,742	3.2	84	72			60	48		
I	"	"	9,000	2.4	9,000	4,500	13,500	1.4	48				36			
B	Columbus	125,560	8,500	6.8	7,964	8,164	16,128	1.9	40				24			
B	Indianapolis	169,000	4,537	2.7	9,600	12,500	22,100	4.8	40				24			
B	Kansas City	163,000	7,200	4.4	6,500	7,500	14,000	1.05	96	75	51		72	60	42	
B	Louisville	204,731	6,604	3.2					96	78	48	36	60	48	30	18
I	"	"	5,000	2.5					48				36			
B	Minneapolis	202,000	9,025	4.5	11,859	7,655	19,514	2.15	84	72	54	18	60	48	36	18
B	Milwaukee	285,000	8,900	3.1	12,529	5,559	18,088	2.0	96	72	60		60	48	36	
B	Nashville	86,000	3,498	4.0		1,030		.29	84	48	36		54	36	24	
B	New Orleans	287,000	6,000	2.1					120				60			
B	New York	1,850,000	63,975	3.5	152,807	2,455	155,262	2.25	240							
B	Omaha	102,000	3,851	3.7	3,571	1,758	5,326	1.4	90	72	48	24	66	48	36	
B	Philadelphia	1,400,000	23,438	1.7	72,618	7,808	80,426	3.5	160							
I	"	"							80	52			48	36		
B	Pittsburg	451,512	11,986	2.5	22,388	13,227	35,615	3.0	125	100	80		100	80	60	
B	Rochester	162,608	4,200	2.6	11,550	800	12,350	3.0	94	64			36	24		
I	"	"	4,200	2.6	3,324	2,011	5,335	1.25	48				30	24		
B	San Francisco	342,000	29,135	8.5	23,565	7,100	40,665	1.4					66	60		
B	St. Louis	575,238	7,851	1.4	8,465	11,940	20,405	2.6	150	100			72	48		
B	St. Paul	166,000	5,715	3.5	7,356	3,297	10,653	1.9	84	72	54	18	60	48	36	18
I	"	"	1,314	.8					48				30			

TARIFF. Measured Service. Business Telephones. 1 Party | 2 Party | 4 Party | Multi Party | Excess Calls. | Com. Box. Residence Telephones. 1 Party | 2 Party | 4 Party | Multi Party | Excess Calls. | Com. Box.

	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
B																			1000 c	1000 c	1000 c			72	62	48		.04
I																		.05								365 c	18.25	.05	.05
B							1000 c	1000 c	1000 c			.04					1000 c	1000 c	1000 c				90	75	60		.04	
B							1000 c					.06					1000 c						52					
B							1000 c	1460 c		1000 c		.05	.05				1000 c	1460 c	1000 c		395 c		92	73	48	18.25	.05	.05
B							1000 c	1000 c	1000 c			.03	.05															.05
I													.05															.05
B																												
B																												
B							1000 c																					.05
B							1000 c					.05	.05															
B																											.015	
I												.05																
B							1000 c	1000 c	1000 c										1000 c									
B							72	62	48			.03							60								.03	
B							1000 c	1500 c	1000 c										1000 c	1000 c								
B							68	60	50			.02	.05						48	36							.02	.05
B							1000 c												1000 c									
B							41					.05							33								.05	
B																												
B							1000 c	1000 c											1000 c	1000 c	1000 c							
B							99	87				.08							90	87	78						.07	
B							1000 c												1000 c									
B							72					.04							72								.04	
B							1000 c	1000 c											1000 c	1000 c	400							
B							78	66				05							69	60	36						.05	
B							1000 c												1000 c									
B							70					.04							70								.04	
B							1000 c												1000 c									
B							70					.06							36								.04	
B							1000 c	1000 c		365 c												365 c						
B							140	104		18.25		.05										18.25					.05	
B							1000 c	1000 c											1000 c	1000 c								
B							69	57				.04							57	5							.04	
B							1000 c																					
B							60					.03															.03	

NOTE.—This table is compiled from various sources and is believed to be fairly accurate within about six months.
In the first column the "B" and "I" signify Bell Plants and Independent Plants, respectively. Under Measured Service the letter "c" signifies "Calls."

mons, and all the other complicated paraphernalia that complete an extensive business organization. All these and more are included in the necessary cost of service, and if only the cloud of mystery that has for so long obscured telephonic practice was dispelled, and the public taken fully into the confidence of the operating company, much of the present friction would be obviated. People would gain not only true appreciation of the service performed for them, and so be more tolerant of tariffs, but would also acquire such a knowledge of the telephonic *modus operandi* as to vastly increase the efficiency of every telephone plant. In this respect the independent companies are setting an admirable example. Frequent conventions take place, at which free and open discussions of all subjects of interest are held, to which all, whether friend or foe, are equally and cordially welcomed. Each week the technical papers of the land chronicle all items of progress in so free and full a manner as to display the most striking contrast to the years of grim and forbidding silence maintained by the older organization.

There appear to be five results that are certain to follow:

First: Many of the present organizations lacking in experience and strength, located in unpromising fields, will go down with the first monetary stringency, throwing by their ruin considerable disfavor on the financial aspect of telephony.

Second: The remaining Independent companies will be forced to adjust their rates until such a point is reached as to enable them to become investments of reasonable earning power, and to this end only the most carefully designed, best constructed and shrewdest managed plants can possibly survive.

Third: The rates of the Bell companies must fall until both the Bell and the Independent meet at a common level and thereafter, so far as the public is concerned, it matters little which gives service.

Fourth: The Independent companies are weak in their lack of coherence, feeble in possessing but few exchanges in the larger towns and almost none in the great cities, and powerless in the toll and long distance field. New York is the keystone of the telephonic arch, and when that city is captured by an Independent company, the battle will be more than half won, but judging from recent developments in this direction, that time is still in the somewhat far distant future.

Fifth: An extensive and far reaching tariff revision is the vital question of the present. If the Bell companies heed the tendencies of the times, they may yet not only retain, but revive a fast diminishing supremacy. Failing in this respect, they will be forced to meet this just demand, either by the struggle for existence in the face of fiercest competition, or by the pressure of ordinance regulations, as has recently been witnessed in Chicago, or by such legislative action as will declare all telephone companies to be common carriers, and compel each to handle and transmit to its own subscribers any messages delivered by the other.

In possession of a country of unbounded resources, the American public is of all peoples the easiest and most tolerant to deal with. It has made money and it expects and wants every one else to do likewise. It is good-natured and somewhat careless as to what it pays, provided good goods are returned, and charges that are equitable and just to all made. But woe betide those who attempt to get something for nothing, or to discriminate unfavorably between different portions of society. Their fate is certain.

It is this inate feeling that has instituted this revolt against the flat rate system. One does not contract by the year with the milkman for all the milk the family can drink, or with the butcher or baker for all the bread or meat, or with the gas company for all the gas one wishes to burn. The electric light people even go so far as to install a demand meter, scaling bills not only upon the quantity of electricity used, but considering also the time at which it is asked for. To charge a subscriber who makes 100 messages per day the same rate as one who makes ten is obviously unfair, and driven from the illogical flat rate system, the plan of an initial charge, plus a message rate for all calls beyond a certain annual number, has gained considerable currency. That this is an improvement and more just than the former method cannot be gainsaid, but even this scheme contains large elements of manifest injustice, for the message is no more the true unit of charge than going to a livery stable and hiring a carriage to take a drive would be a fair basis for the stable man; for one customer might be gone an hour and another all day. The average length of telephonic conversations is about two minutes, but averages are dangerous. In one case under the personal observation of the writer, a young bride on her return from the honeymoon kept the line leading to her mother's house busy on several consecutive days for more than forty minutes at a time. Query: shall the bride be charged 10 cents for her call and you the same price for two minutes' conversation? No; the message rate system, while approximating more closely to the truth than the flat rate, is still on a false basis and should be corrected.

In giving service, telephone companies do three entirely separate and independent things which are incommensurable with each other, all of which every just and equitable tariff must recognize and express.

First: The telephone company supplies and maintains a certain amount of apparatus necessary to connect each subscriber with the central office. This apparatus must be furnished and cared for whether used or not, merely to give the subscribers an opportunity to call. The quantity and quality of this apparatus does not vary with the load, being the same whether the instrument is used once a year or 100 times a day. A flat rate annual tariff sufficient to pay interest, depreciation and maintenance on this portion of the plant is fair and just, and by recognizing varying lengths of subscribers' lines, this charge can be made exactly proportional to the requirements of each station.

Second: The telephone company must maintain a corps of operators to answer subscribers' calls and perform the necessary avocations of connecting subscribers together. This expense is directly and only proportional to the number of times each station calls.

Third: During each conversation, battery is supplied to the subscribers' station for talking, cords, plugs, trunk lines and other common apparatus is in use, the amount and cost of which is proportional to the length of time of conversation.

Therefore, any telephone tariff, to be fair to all, must recognize these three factors, and in so far as any one is omitted, and a blanket charge substituted therefor, injustice will be done, depending on how far the service rendered to a particular station departs from the general average.

To perceive the bearing of this proposition, consider for a moment the cost of installation and service. According to previous telephonic policy, the ratio of the number of telephones to population is very low, as is shown in Table II. Consequently, the installation cost per station has been high. In large cities this has varied from $150 to $250 per station. In medium eities of, say 200,000 population or so, from $90 to $125, while even in the smallest towns it is rare to find a cost of less than $50 per station. Of the installation cost from $10 to $25 is required at the sub-station, depending upon the character and difficulty of wiring. From $15 to $50 for the switchboard, varying with the type of board, size of multiple and percentage of trunking, while the wire plant has absorbed the balance; but if by a more liberal policy the use of the telephone could be so stimulated as to raise the population ratio to, say 15 per cent, it would be possible, even in such a city as New York, to install a tele-

phone plant at a cost not to exceed $60 per sub-station, as is shown in Table III.

TABLE III.

Probable installation cost per station of a telephone plant, sufficient to serve 15 per cent of population:

	Cost.
Sub-station apparatus	$15.00
Wire plant, subscribers' lines	14.00
Wire plant, trunk lines	7.00
Switchboard apparatus, subscribers' lines	12.00
Switchboard apparatus, trunk lines	6.00
Total	$54.00

Assume now that an installation charge of $15 per year per sub-station were made against each one-party line to cover interest, depreciation and the maintenance, $10 per year per station each against two-party line and $8 per year per station against each four-party line and that a charge of one cent was made for each time the central office was called up and one-half cent for each minute of actual time that the telephone was in use. Large business houses and the best class of residences would take one-party lines. Smaller business houses and medium residences two-party lines, while the bulk of subscribers would use four-party lines; all of these being arranged with selective signals and lock-outs to secure the best quality of service. Simply to illustrate the effect of this system of tariff, assume one-party lines to average ten calls per day, two-party lines seven and four-party lines three. Under these circumstances, one-party lines must bear a tariff of $75 per year, two-party lines $52 and four-party lines $23. According to this suggestion, the annual cost of maintenance and depreciation on plant would be cared for by the annual flat rate charge, which, for this purpose, is sufficient in a properly installed and maintained plant. The receipts from traffic would average $20 per thousand calls, while the actual expense should not be over $7 per thousand calls. The difference of $13 would be ample to pay reasonable general expenses and dividends. At each sub-station a meter would be installed, carrying two dials, one showing how many times the exchange is called, and the other the total time expended in the use of the telephone. The meter should be in plain sight of the subscriber, so that he, at any time, could check the readings with his own watch. Such a device could be made and installed at an expense not to exceed $3 per station. Each station would be charged for exactly the service rendered, and it would be optional with all to regulate the charges to suit their wishes.

It is probably an impossibility to make any one method of charging absolutely universal, any more than it is feasible to crowd all passengers on a railway into one car. There must be Pullmans, coaches and emigrant cars. So every telephone company must probably supply a few flat rate instruments, many meter rates and some coin boxes. *"Chacun a son gout,"* but the main idea is that of producing a rate that will be absolutely just, and be capable of so stimulating telephonic business as to place an instrument in every house. Each community contains some chronic objectors whom it is impossible to satisfy, but setting such aside, it seems that a scheme of this general nature would go far towards smoothing out the existing friction between the operating companies and the public.

But with this discussion of the commercial aspect the engineering side must not be entirely forgotten. Two very curious tendencies are observable. Among the older companies and the most advanced Independents, those to whom experience has read some bitter lessons, there is a very strong inclination to design plants with the utmost care and skill, using the widest and best experience for the purpose, and foreseeing the future as far as possible. This is in marked contrast to the practice of a decade ago, when the telephone plants, like "Topsy," simply grew, and in many respects were not unlike the dark heroine of Uncle Tom. But with the newer and less experienced of the Independents, there is a most conspicuous absence of design. Because some farmer has talked half a dozen miles over barbed wire fences, a lot of little telephone companies immediately built toll lines of No. 12 or even No. 14 iron wire, on poles about as large as a walking stick, with grounded lines, through trolley towns, and wonder why their subscribers complain of poor service, or that their lines go down with the first snow.

Conduit construction has settled into pretty well recognized channels, involving chiefly the use of vitrified clay pipe, particularly the multiple duct forms. Periodically, a new and improved form of duct material appears destined to supersede all others, but I notice the tile men serenely go their way, and their output to-day is larger than ever.

The construction of aerial lines is rapidly becoming systemized and proceeding under standard specifications, the tendency of which is to build the lines much more efficiently and much more solidly than in the past, and to restrict the use of open wires to three or four cross arms.

There is a notable tendency to increase the size of cable. Formerly 120 pair was standard for underground work and twenty-five for aerial, but at present 200 pair is becoming almost universal, and even 400 pair has entered the field underground; while aerial cable has grown so that 150 pair is not unknown. For trunk lines and toll work large conductor, low capacity cables are to the front, even to the extent of using No. 16, No. 14 or even No. 12 wire, with capacity of from .06 to .05 M. F. per mile. In switchboard practice, the common battery automatic signal board is rapidly expelling all other forms and soon will apparently reign supreme, for at present there is not a shadow of rivalry looming on the telephonic horizon to dispute its supremacy. While the switchboards of this type are a vast improvement over those of older construction, they still leave much to be desired, and the entire telephonic fraternity wait with open arms the coming of the perfect switchboard. There are many who believe that a purely automatic board will offer the desired solution, but during the past decade the progress in this direction has been almost infinitesimal. A central office seems to be one of those things that needs the human element, and cannot be made purely mechanical. Possibly, the recently invented Faller mechanical operator may form at least a partial solution.

For the sub-station there is no progress to report. The transmitter, receiver and magneto have remained in *statu quo* for ten years, save that each manufacturer dresses his apparatus in a newer and possibly more fanciful design. This is strange when it is considered that actual telephonic efficiency is less than 2 per cent and that a very slight improvement in this direction would be hailed with delight by all, particularly by those who do much toll work. Part of the difficulty lies in the electrical characteristics of the line, and for this Dr. Pupin's epoch-making discovery is supposed to be a panacea, but as yet results from practical experience therewith have not been reported.

In the light of the present, what is the earnest of the future? Despite the hints of our friends of the Hertzian waves, there is nothing at present to suggest any radical discovery in the telephonic field. On the other hand, the art is gradually settling down to that inevitable and comfortable basis wherein sound financial judgment as to the expediency of a telephone plant, skillful engineering in design, the best possible construction, good business management in operation, fairness in the tariff and in the treatment of the subscriber, will be absolutely essential to produce a good balance sheet. Toward this haven strongly sets the current of popular opinion, aided by those who are most broad minded and liberal in the business. May the art safely reach this port, avoiding the Scylla of a disastrous rate war and the Charybdis of financial wreck from rash, ill-advised investments, poorly constructed and operated.

OPERATING AND GOVERNING AN EXCHANGE.

Paper read by A. L. Tetu at Louisville Convention.

The operation of an exchange is composed perhaps of two features—the element of help on one hand and the serving of the public on the other. The first embodies the ability to properly select, rule and educate the employe, and second, to satisfy the public from the standpoint of service and treatment, and likewise to educate the public to a proper appreciation of the possibilities of the service and the part that *it* can play in helping a telephone company perfect its service.

The Independent telephone people are peculiarly fortunate in the fact that trained operators are constantly presenting themselves for employment, and much saving is therefore made in the matter of education and training. The same rules of selection, however, must apply to the trained operator as to the green applicant, and the mere fact that she may have been a successful applicant to some Bell company is no final recommendation to her employment by an Independent company, if for no other reason than that the well-known discourtesy and arrogant treatment of the Bell company's subscribers arises in no small measure from the lack of discipline existing in most of their exchanges and the indifference to courtesy to which their subscribers have been accustomed.

Therefore, the manager or chief operator, upon whom devolves the responsibility of selecting his employees, must have an eye to the selection of such applicants as to his or her mind impress him or her with having the necessary qualifications to insure the courteous treatment of its subscribers, and the *honest, accurate and rapid* handling of the apparatus.

To the trained eye, the manner in which an applicant presents herself for an interview is a safe basis on which to form an opinion as to her qualifications and desirability. The "free and easy-going" applicant might, off hand, appear to be desirable from the point of view that her nerves are less liable to excitement than those of one whose entree is marked by nervousness or timidity; but it must be remembered that while the latter difficulties can, by training be dismissed, the chances are that no training will entirely dissolve the natural difficulty of the applicant first described, the result being that in the case of the "free and easy girl," we are liable to have discourtesy and "freshness," while in the applicant who is at first timid, we may reasonably expect continued courtesy and compliance with the rules.

The proposition of operators for a large exchange is considerably different from that which treats of the operating force for a smaller exchange, and care must be taken in the selection of the employee, not only from the standpoint of the relation to the public, but from the co-relation which must and should at all times exist between themselves, at least while working under the same roof. In other words, the necessity of harmony among the employees must at all times be paramount to good service, and is a necessity which must be insisted upon if beneficial results are to be expected.

To this end, therefore, we must avoid all such characteristics in an applicant as might lead to social or religious differences, and no question of religion should ever enter into the consideration of an applicant's employment.

The first essential of a successful operator are age, voice, reach and education, so far as it is possible to obtain it. It has been proved that girls under the age of eighteen years are less desirable than women between the ages of 18 and 35. An average of perhaps twenty years will insure the greatest possibility for successful training. My recommendation, therefore, is that in the selection of an operator, the choice should fall upon an applicant of twenty years of age. Statistics, I believe, will bear me out in the statement that more regular attendance to their duties follows the employment of girls of this age, than do those of fewer years, while the employment of a girl of greater age means the necessity of abolishing ideas that may be firmly set in her mind, and less inclination on her part to conform to new rules.

The selection of supervising operators is one which entails consideration and discretion. Particularly is this true in the case of a number of employees coming from one company to another at a given time, it being assumed that they were all on the same footing during their former employment. It has been found almost impossible to successfully supervise an exchange by such employees as may have been selected from this newly arrived at condition, not because the supervisors are not willing themselves to follow out your rules, but because the other operators are inclined to resent the new authority, and as a consequence, petty jealousies will ensue to the detriment of your service and your discipline. The inference then is that a selection of supervisors, or at least a chief operator, must be made from among strangers to the new employees.

Having settled upon the personnel of your operating force, the next question to be considered is how shall they be treated with a view to securing the best results to the company. There can be but one answer to this: "Treat them as you would have your own sister or daughter treated were she placed under like conditions." That means then what? First, that they shall be assured fair and just treatment at the hands of the officers of the company, to whom they shall have, at all times, the right of appeal in the event of a questionable decision at the hands of their immediate superior. Second, that they shall be provided with comfortable, cleanly and healthful surroundings and conveniences. Third, that they shall be made to feel that the company regards them as an important component part of its organization, and as such, that they will at all times be protected against the possible abuse of discourteous subscribers, even to the extent of removing the telephones from such subscriber's place, in the event of the abuse being continued, and be guaranteed courteous treatment by their fellow workers. Fourth, they must be made to believe that the company has an interest in them apart from the mere service which they may render, and in turn will expect from them an interest, which does not cease with the signing of the pay roll. Fifth, as a means of further engendering the loyalty and interest of the operator, she should be invited to suggest from time to time such improvements, or such possibility for improvement, of the service as may make themselves apparent to her from time to time in the ordinary course of her work, and for such suggestions, a fair amount of money should be appropriated each year; the suggestions to be considered semi-annually by a committee appointed for that purpose and awards made at the same period.

The relation of the operating department to the maintenance and construction departments, is material, for the reason that without successful maintenance and construction, successful operation is of course impossible.

We are then led to the condition which requires us to treat the men of our organization with the same consideration as we do our women, not to the point perhaps of furnishing them their luncheon, for the reason that their salaries better enable them to procure this for themselves. But the individual treatment of the male employee should differ in no way at the hands of the officers of the company from that of a woman; the paramount idea being to establish an esprit de corps, which will not only bring about a happier working relation between the several departments, but more firmly instill the spirit of loyalty to the company. The loyalty to the company in this instance means, primarily, the best results at the least possible cost, and with the idea of fair treatment instilled into the minds of our men, we are led to expect close application to their work, to the end that not only may troubles be quickly relieved, but to insure a continuance of the employment of a desirable member of the organization.

MANUFACTURERS' SECTION

CHICAGO TELEPHONE SUPPLY COMPANY.

Chicago telephones are now manufactured in Elkhart, Indiana. The reasons are at once apparent, when the factory and shipping facilities at the new location are taken into consideration.

The Chicago Telephone Supply Company was one of the pioneer Chicago factories. It began the production of Chicago telephones, in a small way, as long ago as June, 1895. In those days the people were yet in the power of the Bell monopoly and few and far between were the opportunities for installing Independent equipment. The little factory in Quincy street, where the Chicago factory began operations, was not as large as the office of its purchasing agent in its present location, and the original force consisted of two men and a boy.

G. A. BRIGGS.

A. J. BRIGGS.

It was in that first little factory that it was determined to make every telephone man know that "Chicago Telephones Satisfy," and the present position of the Chicago Telephone Supply Company in the Independent field shows how well that motto has been constantly kept in mind and adhered to.

In 1897 the growing business demanded larger quarters and consequently space was secured at 28-32 West Washington street, only a small portion of the building being rented. Floor by floor additional space was secured until further growth in that location was impossible, when in October, 1901, the factory was removed to a much larger building at 133-139 South Clinton street. Here the same growth absorbed the available space in that building and made it necessary to rent one additional floor in an adjoining building for manufacturing purposes and a smaller building in Jefferson street for storage and stock.

The management had been caused great inconvenience by the frequent necessity for securing more space and larger quarters. Consequently, they began to look for a location that would provide for present needs and offer an opportunity for future growth. At the same time it was determined that when the new location was found it should free the company from heavy payments for rent, should be light and clean, located where shipping facilities were best, and where labor troubles were least likely to occur.

At this point it was realized that to secure all of these advantages it would be necessary to leave Chicago.

After many locations were investigated Elkhart, Indiana, was chosen.

Here the new factory was built on a five acre tract of land, new departments were added and at the present time the Chicago Telephone Supply Company is producing from raw material everything necessary for the production of common battery and magneto switch boards, telephones, parts and supplies. The entire plant, including ground, building, machinery and stock, is owned by the Chicago Telephone Supply Company, so that it is now freed from all payments for rent. The factory is so light that no workman uses artificial light.

Elkhart is located on two trunk line railroads going east, one going south and a belt line railroad going west which crosses every western line running out of Chicago. Since no shipments have to go through the congested freight houses of Chicago and since the belt line railroad referred

to, makes advantageous rates all shipments it is claimed will reach their destination quicker and with lower rates in many cases and higher in none. The company guarantees to pay any excess freight that may be charged its customers and solicits correspondence in the event of overcharges. The company has a railroad switch to the door of the shipping room and thus saves all of the heavy charges for drayage which were unavoidable in Chicago.

Elkhart is a city of twenty-five thousand population, one hundred miles east of Chicago. It is a typical city of homes, and in the forty factories that are located there, no strike has ever occurred.

The Chicago Telephone Supply Company makes a complete line of telephone apparatus, and has devoted its best talent to the production of equipment for medium-sized exchanges, toll lines, and party lines.

The common battery department produces switchboards of both lamp and target types for exchanges of three thousand subscribers and less. The circuit is not complicated and is in entire accord with standard practice, but does not employ the large number of relays and impedance coils that are to be found in so many boards designed during the last few years.

The Chicago central energy transmitter is claimed by the company to be the only one that does not infringe on the patents held by the Bell Telephone Co. Chicago common battery telephones are built on standard lines and are said to employ all features that experience has shown to be desirable.

The Chicago Express switchboard is intended for medium-sized exchanges using telephones equipped with generators and local battery. It is the acme of efficiency and simplicity, every part being self-contained and instantly removable. But of all apparatus produced by this factory none excel in popularity Chicago six bar bridging telephones. It is claimed that more Chicago bridging telephones are in daily use than those of any other factory in the world.

The growth of rural lines has been the most astonishing feature of the telephone business in recent years. The Chicago Telephone Supply Company has organized a Promotion Department to look after this branch of its business, and this department offers its services to local exchanges for the purpose of developing such business so as to create harmony between the exchange and the farmer. Exchange managers are cordially invited to investigate this plan which is claimed to be the best one yet devised for avoiding antagonism between the exchange and the farmer. The Chicago Telephone Supply Company believes that the best interest of the exchange, the farmer and the factory are identical and wherever its plan has been tried it has been highly praised by both the exchange and the farmer.

The export business of the Chicago Telephone Supply Company is an important department and the bells of Chicago telephones are heard around the world. Central America, South America, the Philippines, Hawaii, Japan, China, India, Holland and Australia are the leading foreign markets in which Chicago appartus finds a steady sale.

FACTORY—CHICAGO TELEPHONE SUPPLY CO., ELKHART, INDIANA.

The wonderful growth of this factory is a tribute to the prosperity of our country and the virility of the Independent movement. No other field of endeavor has opened up such a vista of possibilities, and the Chicago Telephone Supply Company, by its high aim and broad lines of organization has grown to its present large proportions.

The present official personnel of the company is as follows: President, G. A. Briggs; secretary, H. L. Briggs; general manager, A. J. Briggs; purchasing agent, H. C. Randall; manager promotion department, H. P. Didriksen; superintendent engineering department, S. A. Duvall; superintendent machine department, F. Becker; superintendent telephone department, M. B. Brooks; superintendent raw material department, G. A. Randall; superintendent generator department, C. A. Johnson; superintendent receiver department, C. H. Bevans; superintendent switchboard department, H. R. Cook; manager accounting department, T. Y. Lynch.

PRESIDENT'S OFFICE—CHICAGO TELEPHONE SUPPLY CO.

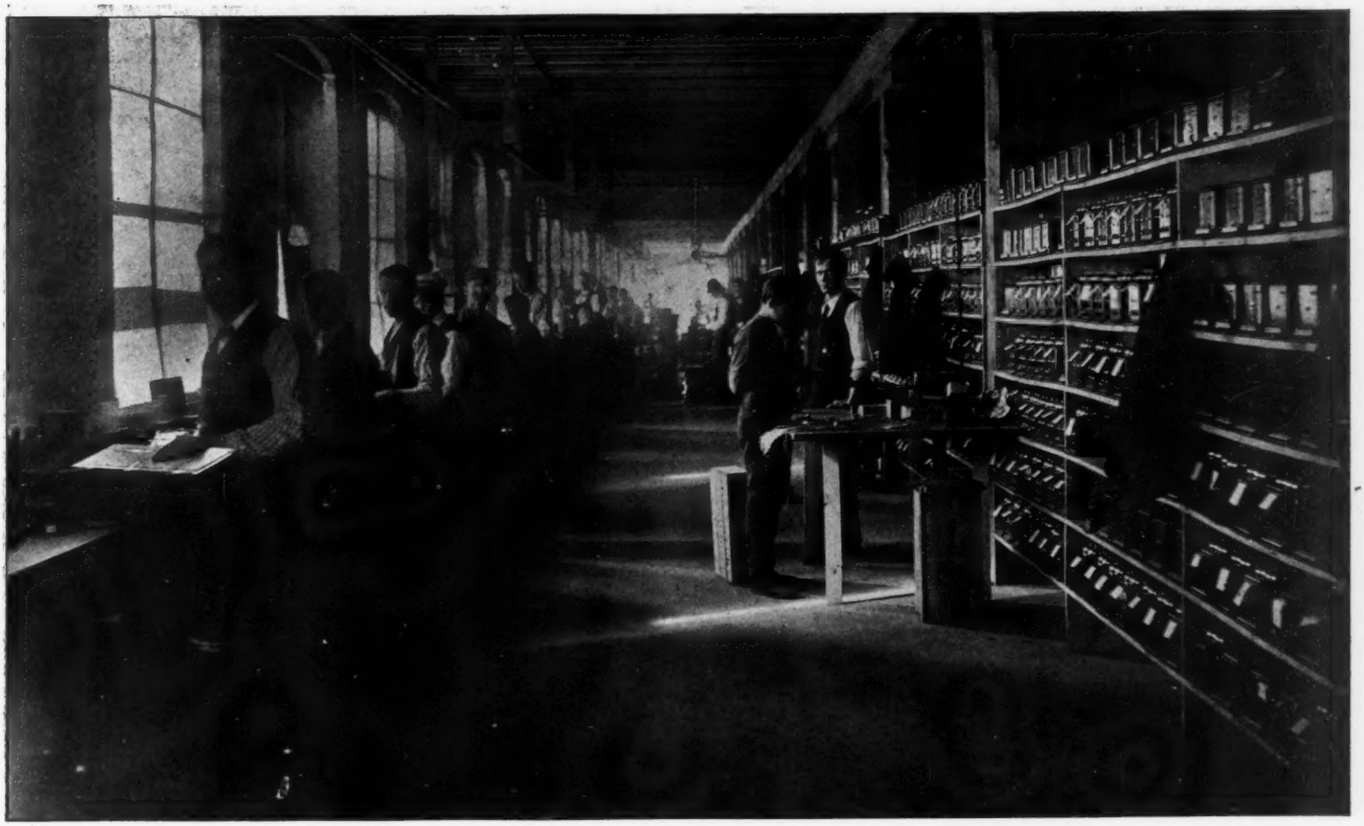
GENERAL MANAGER'S OFFICE—CHICAGO TELEPHONE SUPPLY CO.

PURCHASING AGENT'S OFFICE—CHICAGO TELEPHONE SUPPLY CO.

PROMOTION DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

ACCOUNTING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

STENOGRAPHIC DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.



TELEPHONE ASSEMBLING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

GENERATOR SECTION OF STOCK ROOM—CHICAGO TELEPHONE SUPPLY CO.

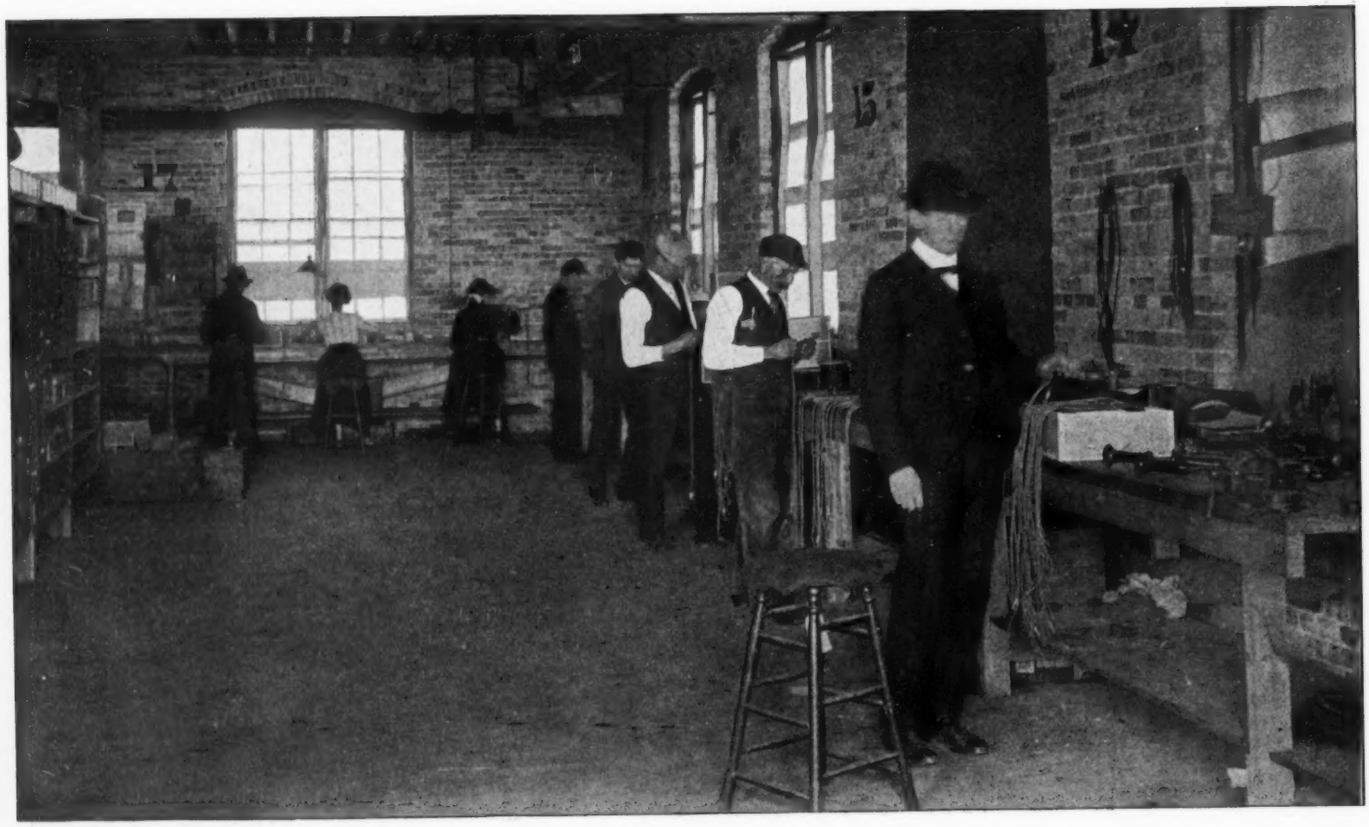
SCREW MACHINE SECTION—CHICAGO TELEPHONE SUPPLY CO.

GENERATOR ASSEMBLERS—CHICAGO TELEPHONE SUPPLY CO.

WINDING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

SECTION OF SWITCHBOARD DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

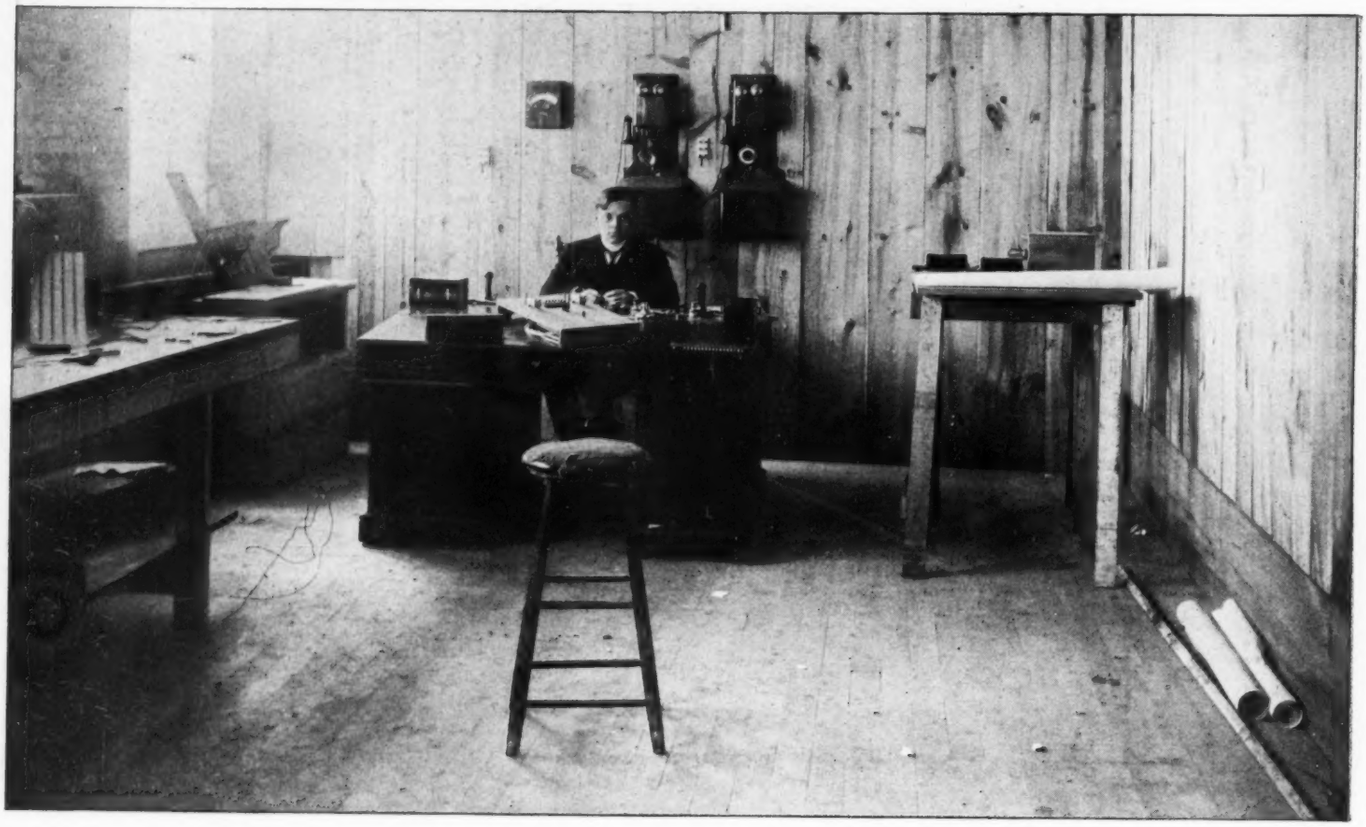
SECTION OF STOCK ROOM—CHICAGO TELEPHONE SUPPLY CO.



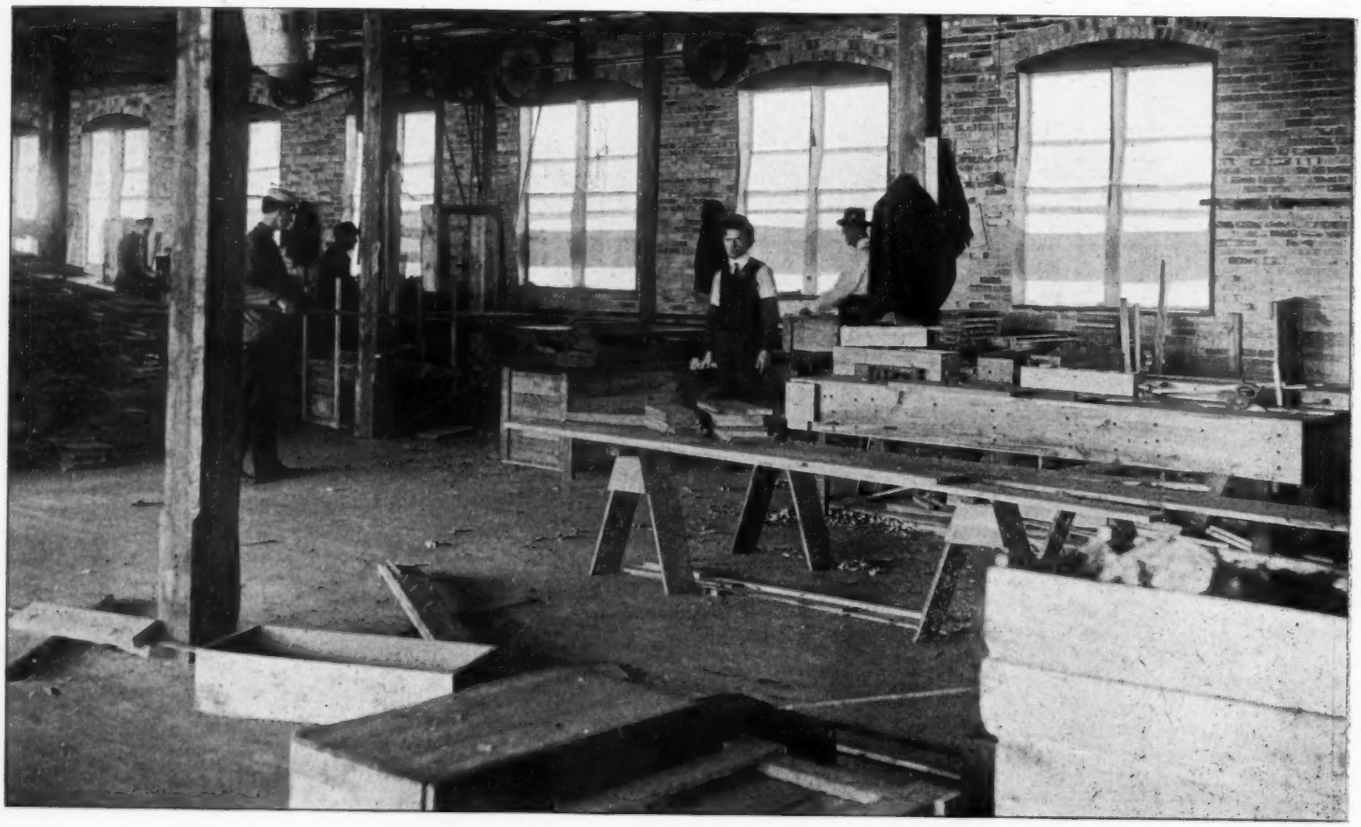
RECEIVER DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

SECTION OF MACHINE DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

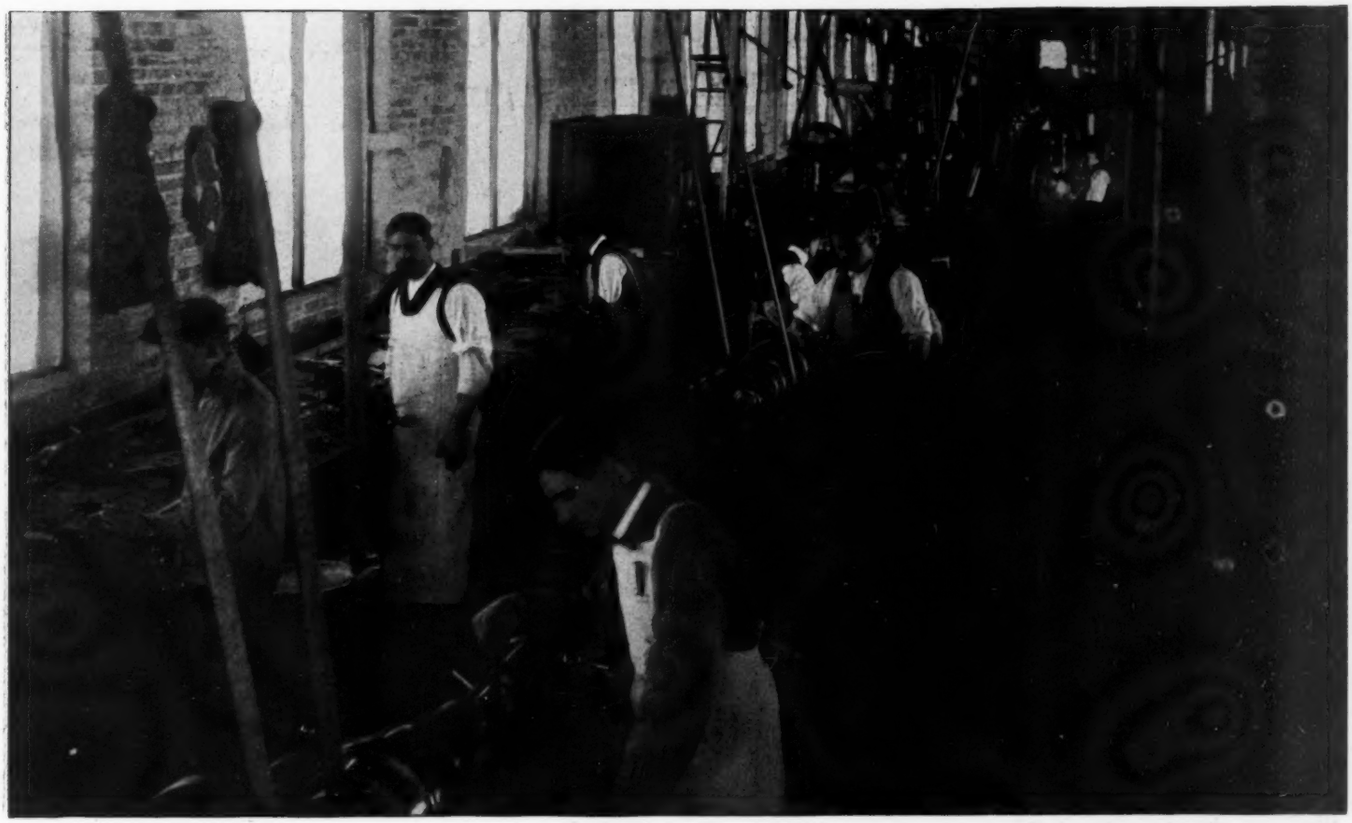
PACKING BOX DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.



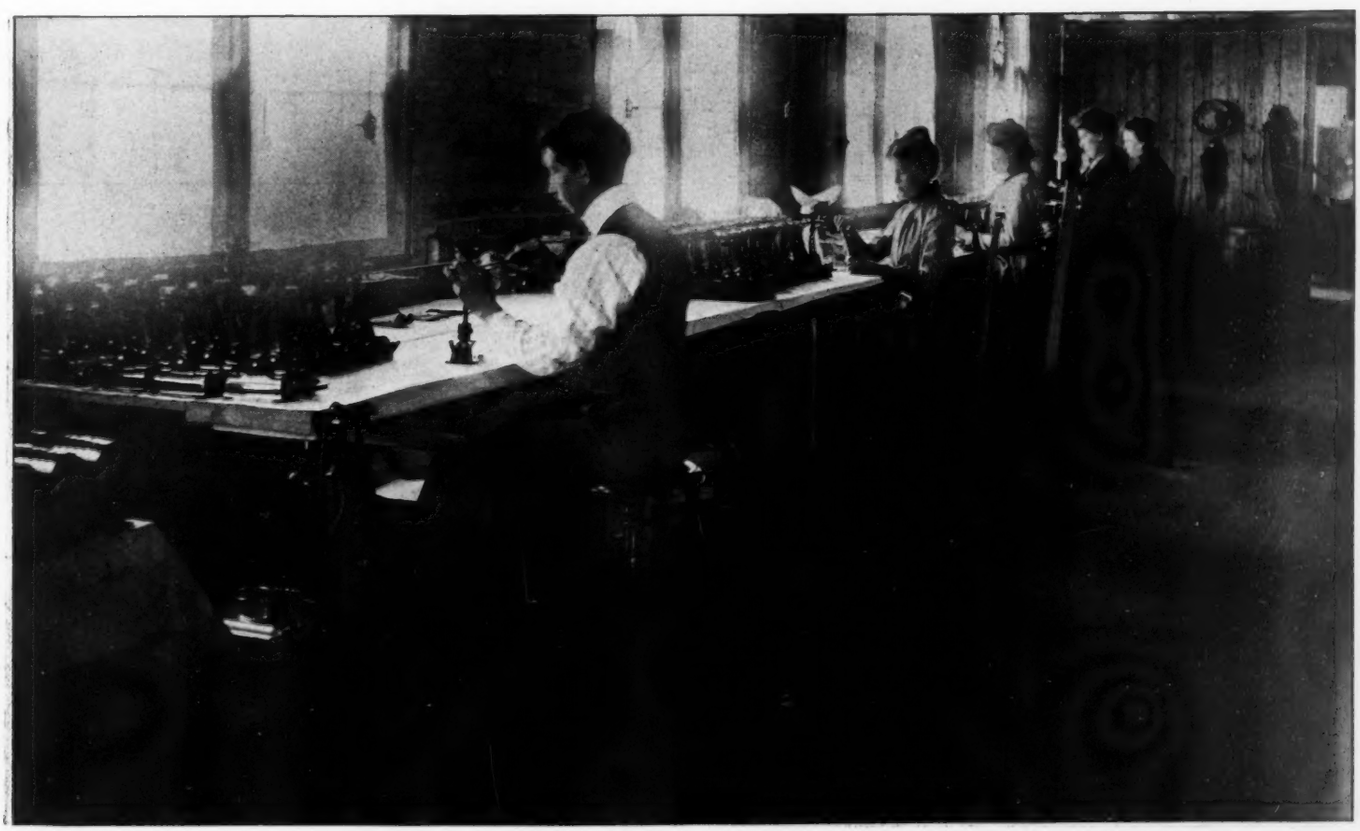
LABORATORY—CHICAGO TELEPHONE SUPPLY CO.



PACKING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.



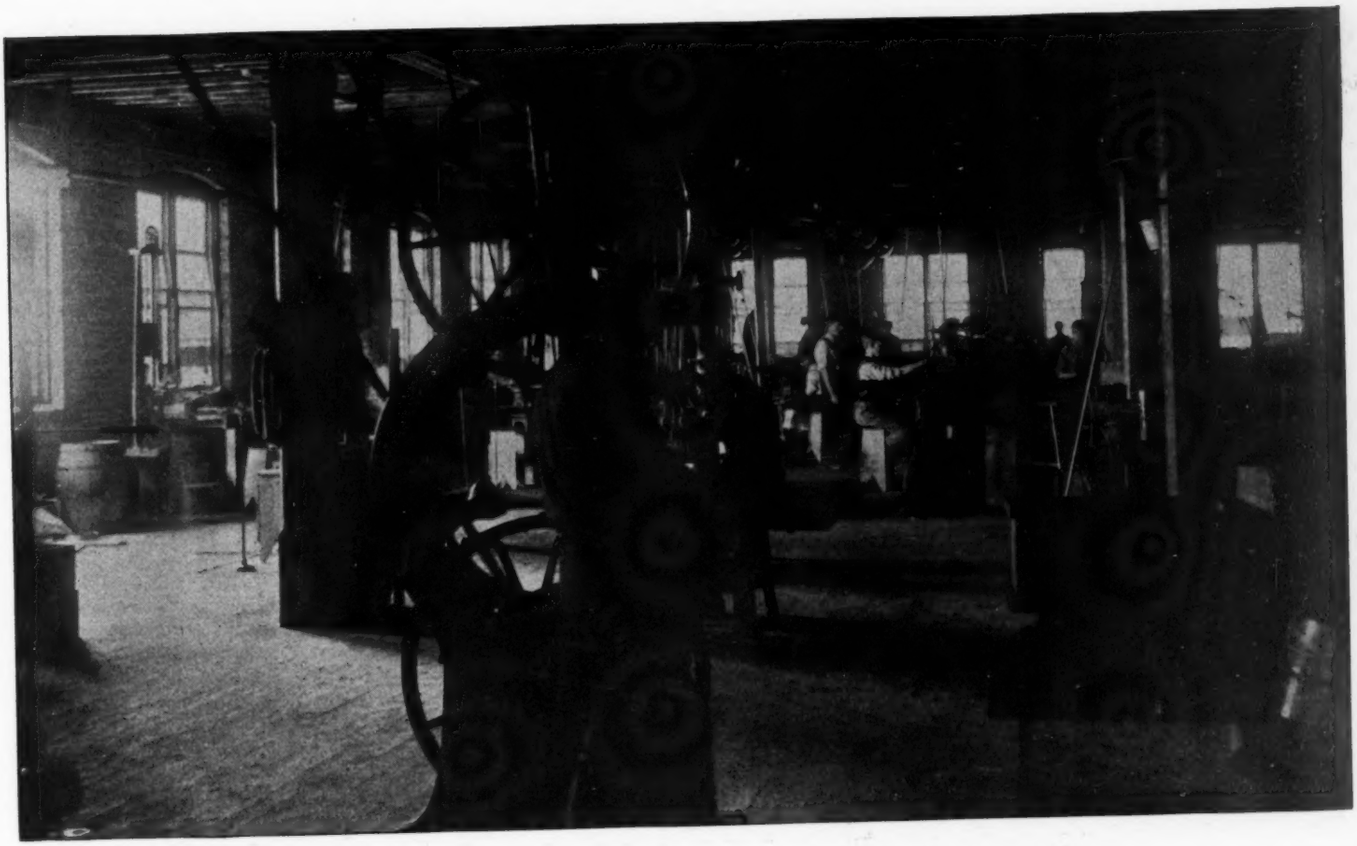
TOOL ROOM—CHICAGO TELEPHONE SUPPLY CO.



TRANSMITTER ASSEMBLING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

PUNCH PRESS SECTION—CHICAGO TELEPHONE SUPPLY CO.

FOUNDRY—CHICAGO TELEPHONE SUPPLY CO.

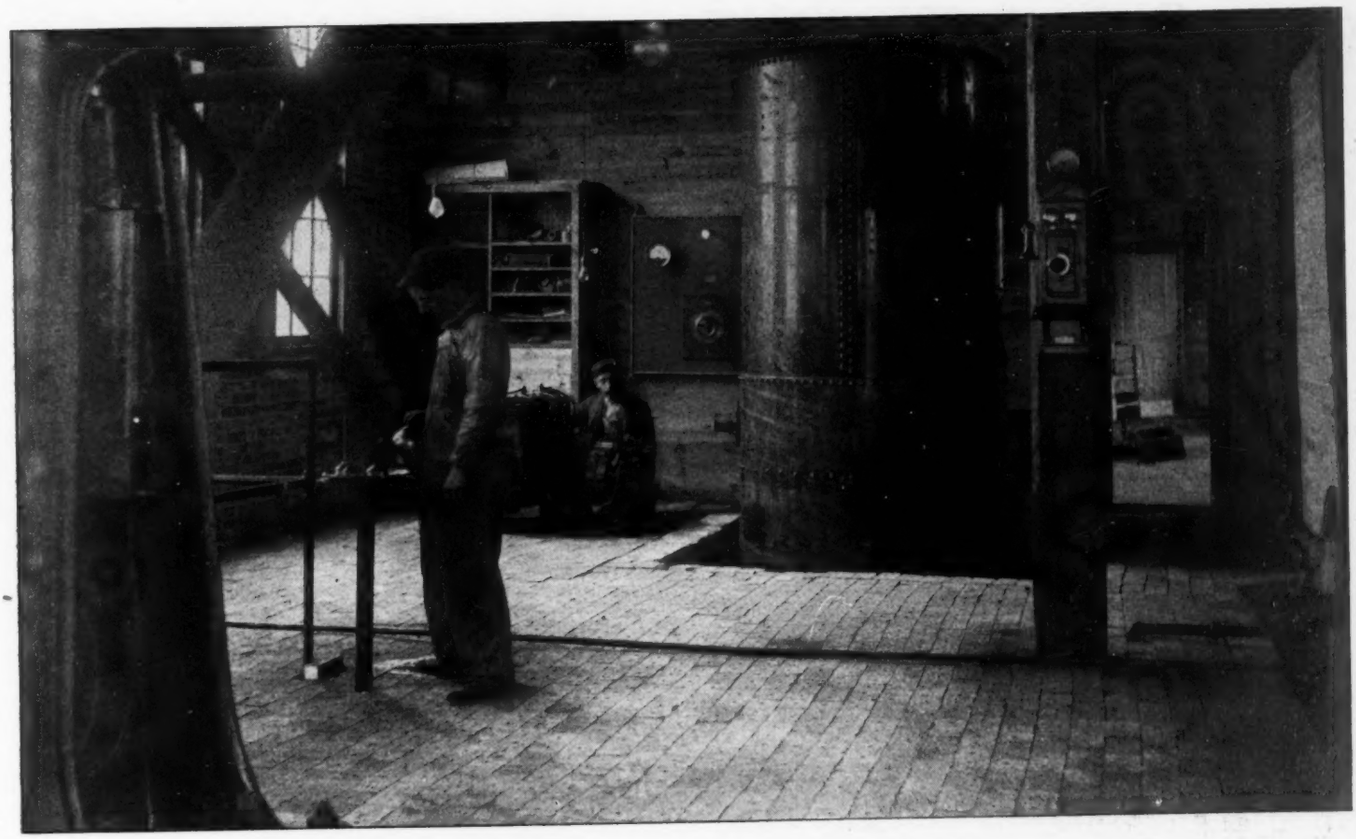


SECTION OF MACHINE DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

TEMPERING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

NICKEL PLATING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.

BUFFING AND POLISHING DEPARTMENT—CHICAGO TELEPHONE SUPPLY CO.



ENGINE ROOM—CHICAGO TELEPHONE SUPPLY CO.

ASSEMBLING DEPARTMENT, CHICAGO TELEPHONE SUPPLY CO.

W. G. Nagle Electric Company, Toledo, Ohio.

The W. G. Nagel Electric Company is one of the largest telephone, electric light and street railway supply houses in the middle west. The business was started four years ago by W. G. Nagel in a small store room; in 1890 the company moved to new quarters and in 1891 an additional building was required. The third building is now in course of construction and when completed will be used exclusively as a warehouse for cross arms, pins and brackets. The present company was incorporated in 1901 under the laws of Ohio. The officers are W. G. Nagel, president and general manager; Philip Nagel, vice-president, and R. B. Crane, secretary and treasurer. H. E. Adams is manager sales department, E. J. Paradis and James W. Wood are the company's Ohio salesmen, E. A. Cassin is Michigan representative and A. V. Riddle is Indiana salesman. The principal office and store rooms are at 520 Adams street and the warehouse and shipping department are in the adjoining building, 416 Huron street. The present floor space in the two buildings is nearly fifty thousand square feet. The mail order business of the company is very heavy, as is its export trade. The territory of the company comprises the entire middle west, while its specialties are sold all over the world.

SUPPLY HOUSE, W. G. NAGEL ELECTRIC COMPANY, TOLEDO.

Aside from carrying a complete line of telephone and electrical supplies the company manufactures a number of specialties, among which are the Ready construction tools, Ready telephone pole houses, Ready telephone pole seats, Ready telephone pole balconies, Ready cable arms, Ready cable trolleys, Ready cable cars, Ready duct rods and underground specialties, as well as the now well-known Ready pay out reels. The company also manufacture a complete line of telephone apparatus, which is meeting with a wide sale.

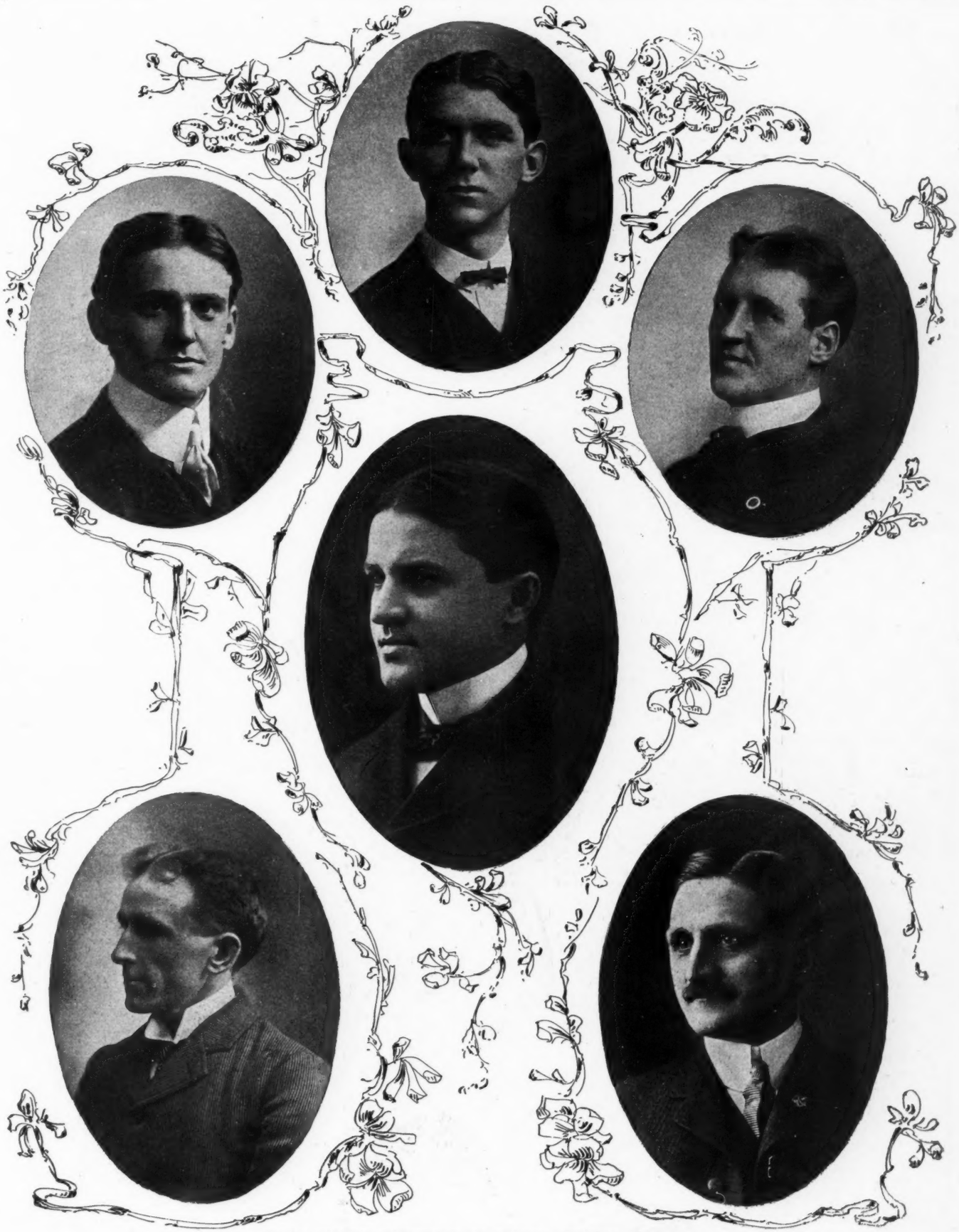
Toledo is one of the best shipping centers in the United States, with twenty-three railroads, six inter-urban electric lines and the best harbor on the lakes, which enables the company to reach any point with unusual promptness. These facilities coupled with the company's method of promptly executing orders, has done much to build up the present business. The company carries in stock everything necessary for the construction of a telephone system.

The company's president, W. G. Nagel, was born in Wapakoneta, Ohio, May 22, 1873. He graduated in electrical and mechanical engineering courses at the Ohio State University. After leaving college he entered the electrical supply business and has been identified with it ever since. He was one of the pioneers in the Independent telephone field in Ohio and has been successful in his undertakings. The institution of which he is the head is an example of what can be accomplished by pluck, brains and hard work, and his success is deserved.

H. E. Adams, the company's sales manager, is too well known to need more than passing mention. He has been in the electrical supply business for fifteen years, and probably no one is better or more favorable known.

WAREHOUSE, W. G. NAGEL ELECTRIC COMPANY, TOLEDO.

On the opposite page is shown the portraits of the officers of the company as well as the traveling representatives of the middle western states. On the pages immediately following are shown some views, both in the supply house and warehouse of the company.



W. G. NAGEL ELECTRIC COMPANY, TOLEDO, OHIO.

JAMES M. WOOD.

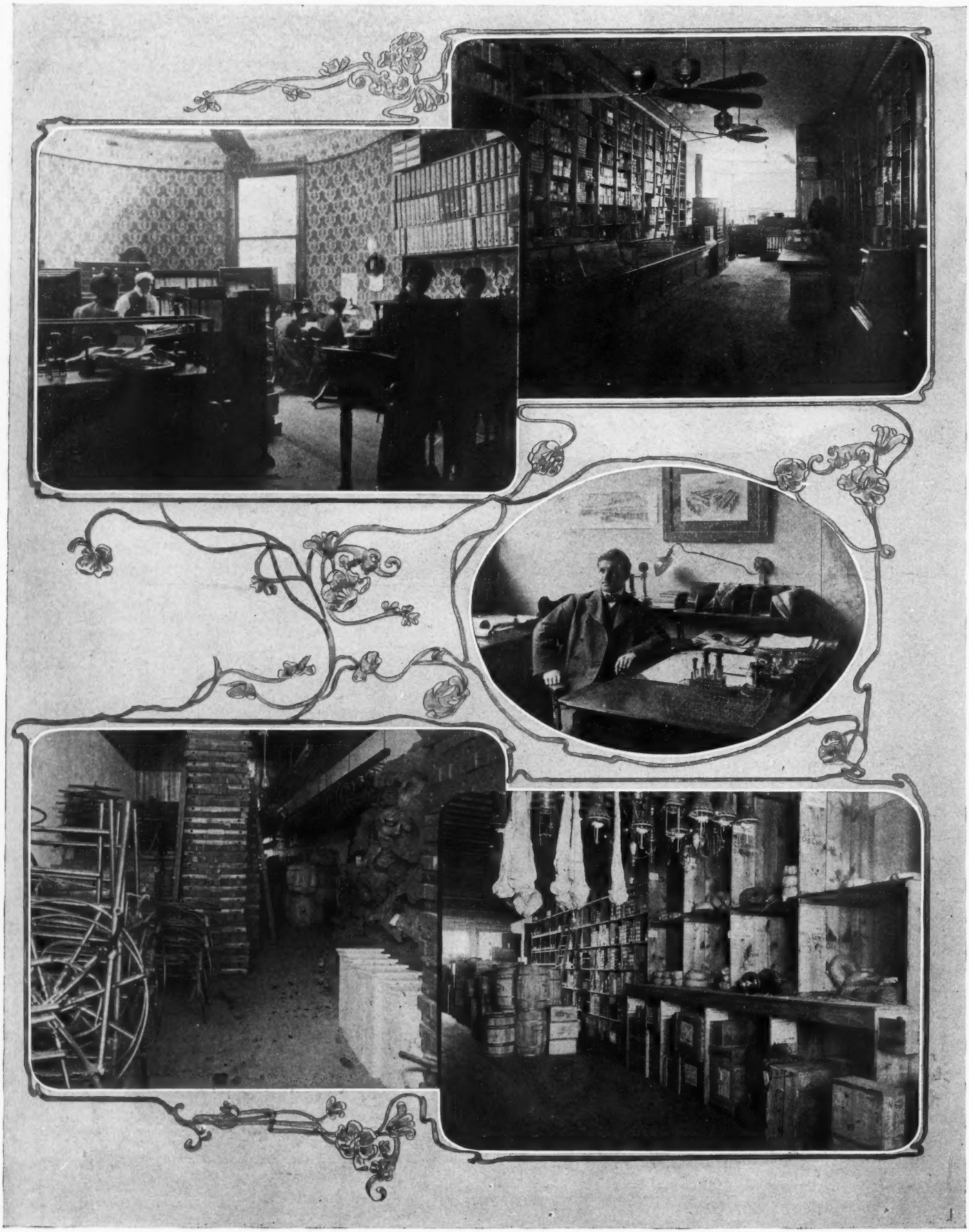
E. A. CASSIN.

W. G. NAGEL.

E. J. PARADIS.

H. E. ADAMS.

B. B. CRANE.



W. G. NAGEL ELECTRIC COMPANY, TOLEDO, OHIO.

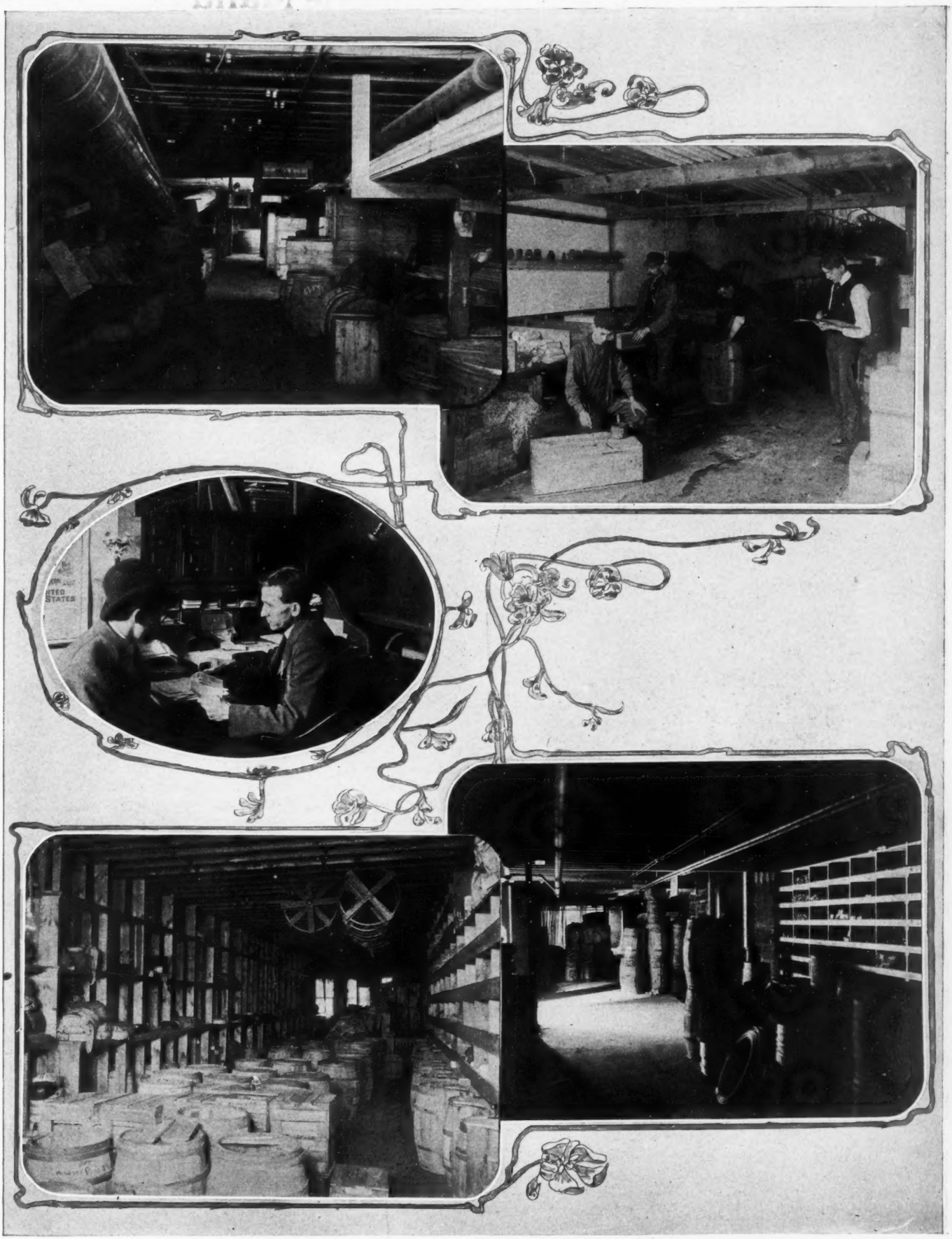
ACCOUNTING DEPARTMENT.

VIEW SECOND FLOOR, WAREHOUSE, HURON ST.

SALES ROOM, ADAMS ST.

PRESIDENT'S OFFICE.

VIEW SECOND FLOOR, ADAMS ST.



W. G. NAGEL ELECTRIC COMPANY, TOLEDO, OHIO.

VIEW BASEMENT, ADAMS ST.
SALES MANAGER'S OFFICE.
WIRE DEPT., ADAMS ST.
CORNER OF SHIPPING ROOM.
HARDWARE DEPT., HURON ST.

The International Telephone Manufacturing Co.

One of the most promising and rapidly growing manufacturing companies in the Independent field is the International Telephone Manufacturing Company of Chicago. This company was organized under the laws of the State of Illinois on October 29, 1901, with a capital stock of $100,000.

The company's president, Henry Shafer, and its vice-president, W. E. McCormick, are both well known in the telephone and electrical field. Its secretary, John C. Burmeister, is one of Chicago's leading business men of high standing. The treasurer of the company, R. N. Stites, one of the principal owners of Rector's, Chicago, is one of the most prominent restaurant men in the United States. Mr. D. A. Clithero, of Warnelle & Clithero, the company's legal council, is one of Chicago's foremost corporation attorneys.

Among others who are financially interested in the company are Mr. Paul Wenigman, manufacturer of electrical specialties, and Mr. L. E. Myers, of the L. E. Myers Construction Co., general contractors and builders of steam and electric railways.

HENRY SHAFER.

The company secured control of a large number of inventions and newly designed apparatus on which patents had been allowed to W. E. McCormick. These inventions covered new features in the construction of practically every detail part of a complete line of telephone apparatus.

This placed the company in a position to commence furnishing complete telephone equipment for any style or size plant.

Practically every working part of the equipment being its own design and embodying new features in construction, necessitated making a full set of special tools and dies for manufacturing the various systems, which enabled the company to manufacture all parts directly from the crude material, under its own supervision.

One of the first orders this company received was a two thousand four hundred line capacity, five hundred line equipped central energy lamp miltiple switchboard with double supervisory clearing-out signals. Notwithstanding the fact that the company was required to make special machinery and dies for manufacturing every part of this equipment, the order was shipped out within the first six months of the company's organization, or in less than four months from the date of the contract.

W. E. M'CORMICK.

JOHN C. BURMEISTER.

Before the close of the first year the company had made the unparalleled record of shipping one two thousand four hundred capacity, five hundred equipped multiple central energy equipment; four section of six hundred line of a twelve thousand capacity multiple central energy system; two five hundred and sixty capacity, two hundred and eighty equipped central energy systems with multiple capacity, for exporting, including a large number of smaller orders as well as having well under way a two thousand four hundred capacity, one thousand line equipped central energy multiple capacity equipment; a four hundred line hotel system and a two-section public exchange trunking central energy equipment.

Every separate piece of the equipment is made with a special toll or die, insuring absolute uniformity in all like parts. The various parts of the complete instruments are accurate in every particular when they leave the machine department and are assembled without the use of a file or vise.

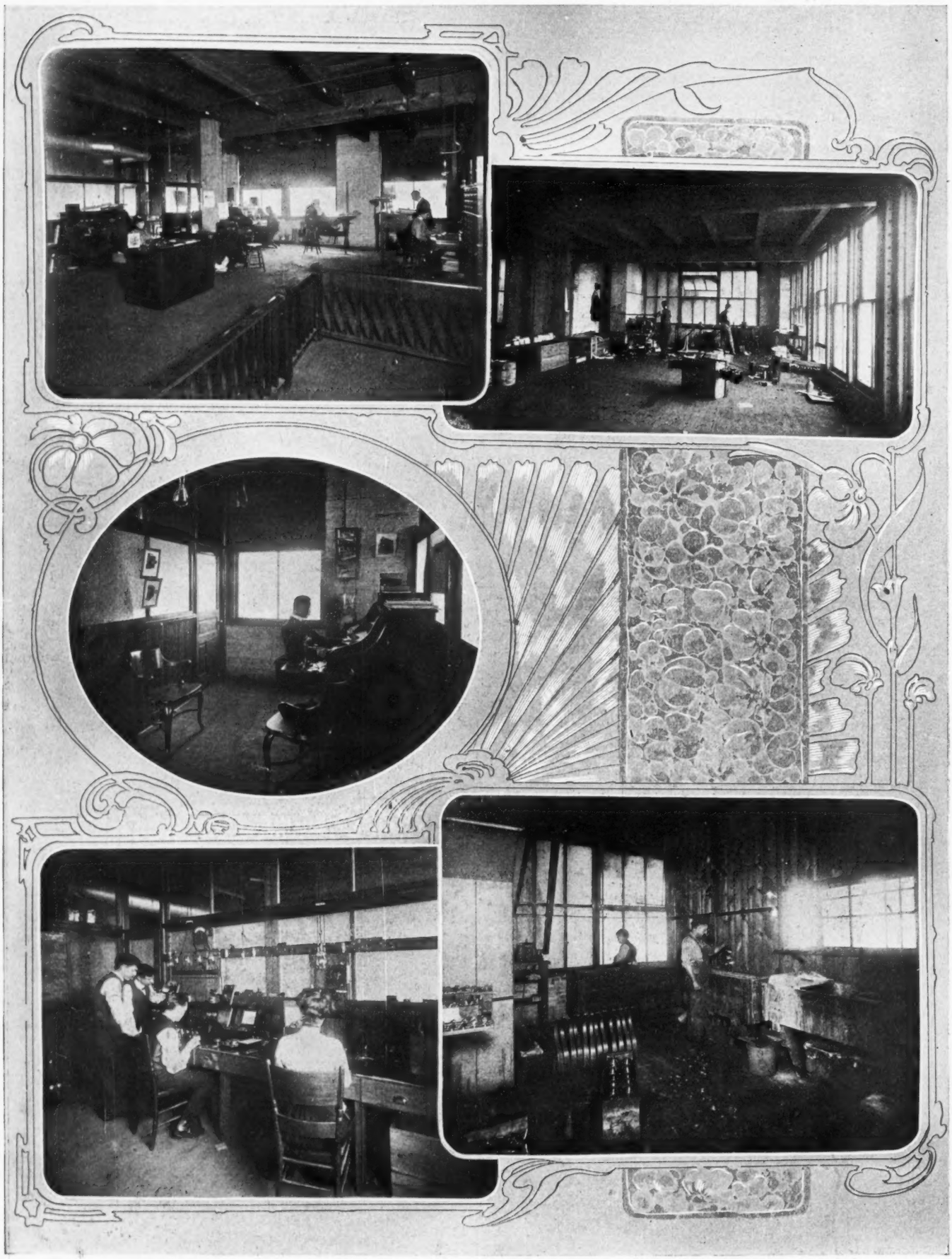
R. N. STITES.

D. A. CLITHERO.

This policy is carried out in every detail, the same as in the best watch factories.

The completeness of the manufacturing plant, the improved designs of its apparatus and the very high class of workmanship in the equipment, has placed the company in the foremost ranks of the telephone manufacturing field.

TELEPHONES
INTERNATIONAL TELEPHONE MFG. CO.
CENTRAL ENERGY
MAGNETO CALL
TELEPHONES
SUPPLIES
CENTRAL ENERGY TRUNKING
AND MULTIPLE SWITCHBOARDS
TOLL LINE EQUIPMENT
INTERNATIONAL TELEPHONE MFG. CO.



INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, CHICAGO.

GENERAL OFFICE.
PRESIDENT'S OFFICE.
EXPERIMENTAL AND TESTING ROOM.
CONDENSING DEPARTMENT.
PLATING DEPARTMENT.

INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, CHICAGO.

TOOL MAKING DEPARTMENT.

MAIN MACHINE ROOM.

DISPLAY ROOM.

TELEPHONE ASSEMBLING DEPARTMENT.

SWITCHBOARD DEPARTMENT.

Roth Brothers & Company, Chicago.

This firm started business in March, 1894, at 30 South Market street, under the name of Roth & Eck, in a small room. The firm then consisted of Alfred G. Roth and Chas. A. Eck. Their first venture was fan motors, which they built during the spring and summer of that year, and in the fall they took up the manufacture of dynamos and motors up to three and one-half H. P. In March, 1895, Chas. H. Roth bought out Mr. Eck's interest, and since then the firm has been known as Roth Bros. & Co. In August of the same year Gustav A. Roth bought a one-third interest

G. A. ROTH.

in the company. The firm worked hard during the next few years; moved its business into larger quarters in the same building and occupied a space of 50x80 feet, when on the night of February 28, 1899, fire destroyed the entire plant. Nothing daunted, it started again and within twenty-four hours after the fire, had secured new quarters at 88-92 West Jackson street, its present location. At this time, the firm started the designing of a machine adaptable for general uses, both as a motor for power purposes and a dynamo for lighting. These machines were built in sizes up to 7½ H. P., as motors, and up to 110 light capacity as dynamos, and on April 1st it shipped the first machine of this type.

The success with this machine was so great, that before the year was up the company found it necessary to double its floor space, and in the following spring it took up another floor. During the year 1901, upon the urgent request of customers, the company was obliged to design machines up to 20 H. P.

At the time of moving into the new building, the company also took up the manufacture of telephone power apparatus, and it is now among the leaders in this branch of the trade, furnishing telephone power apparatus to the leading telephone manufacturers of the country. The company make a specialty of charging machines, plain ringers, also ringers equipped with howler, busy back and intermittent ringing devices. Among local customers might be mentioned the Chicago Telephone Company, Stromberg-Carlson Telephone Manufacturing Company, International Telephone Manufacturing Company, Kellogg Switchboard & Supply Company, and the Eureka Electric Company.

In March, 1902, the firm was incorporated, under the laws of the State of Illinois, with a capital stock of $25,000. The officers of the company were Alfred G. Roth, president; Chas. H. Roth, vice-president, and Gustav A. Roth, secretary and treasurer, until the death of Alfred G. Roth, September 9, 1902. Since then Charles H. Roth has been elected president, William F. Roth vice-president, and Gustav A. Roth, secretary and treasurer. The company also increased its capitalization to $160,000, and is now making arrangements to move into larger quarters, and increase its facilities, to enable it to double the output.

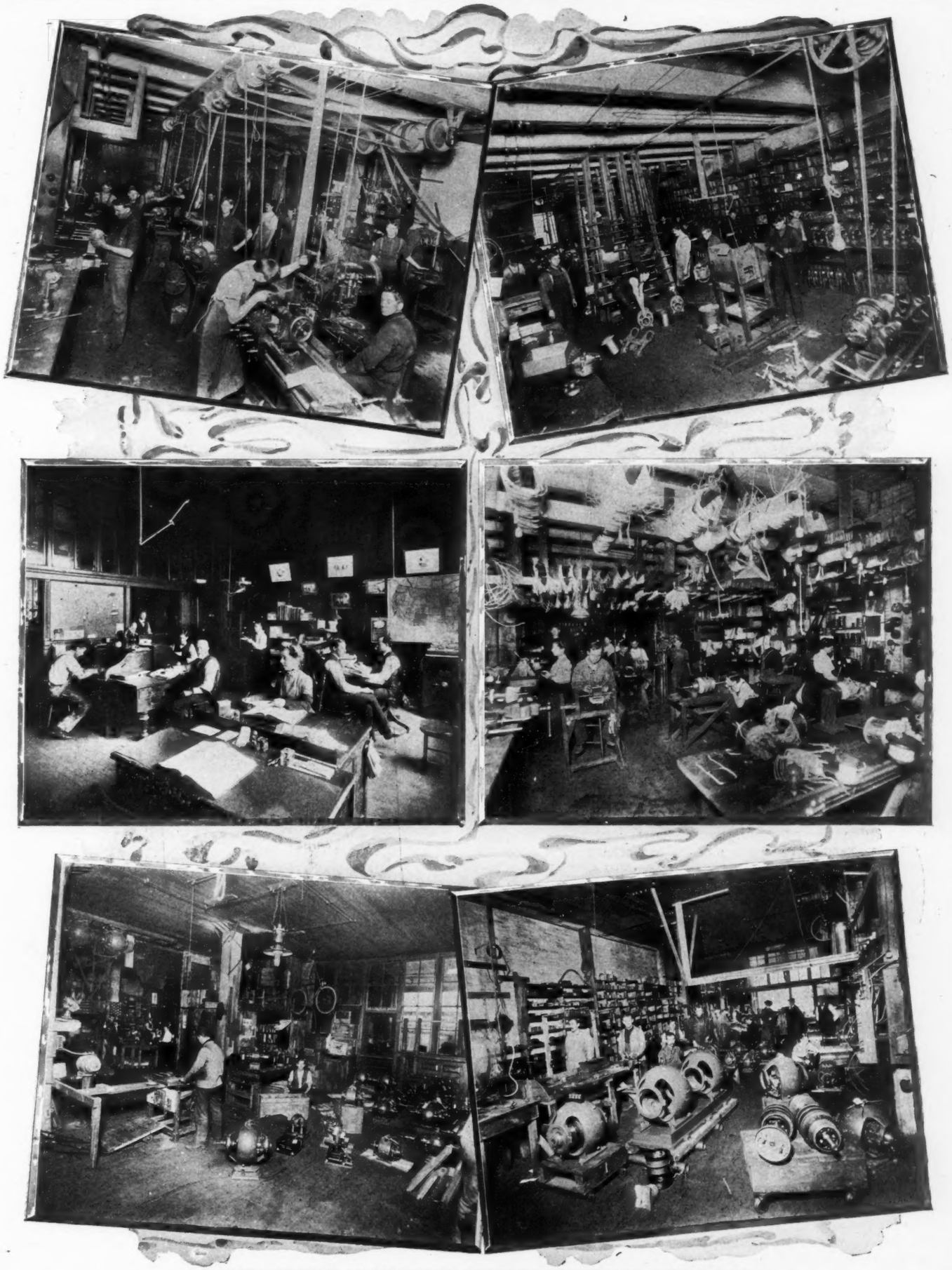
It has lately taken up the matter of motor drive for all kinds of machinery in machine shops, etc., and has gotten

C. H. ROTH.

out the electric counter-shaft, which is a back geared motor with a cone pulley on the back gear shaft, used the same as a counter-shaft for lathes, or any other kind of machines, and orders for these machines are coming in faster than the company can conveniently take care of them.

In fitting motors to printing presses, Roth Bros. & Company are well known, and many printing plants are in operation, in which its machines are used.

The Pennsylvania Railroad Company has placed complete telephone outfits on many of its wrecking trains and it is said that the company intends to equip all trains with telephones.



MANUFACTURING PLANT ROTH BRO THERS COMPANY, CHICAGO ILL.

MACHINE SHOP.
GENERAL OFFICE.
SHIPPING DEPARTMENT.
STOCK ROOM.
WINDING ROOM.
ASSEMBLING AND TESTING DEPARTMENT.

THE NEW "STANDARD" TRANSMITTER.

Following out the line of improvement which has been its policy, The Standard Telephone & Electric Company, Madison, Wis., has recently designed and is now ready to place on the market a new transmitter. In its design a number of new features have been incorporated which simplifies its construction, making it less apt to get out of order. Figure 1 shows the general outside appearance of the instrument, which is seen to be neat and compact, presenting a pleasing and artistic outline. The front is of cast brass made heavy enough so that there will be no secondary vibration to interfere with the perfect articulation of the transmitter. The back or cup is made of heavy sheet brass pressed into shape. The mouthpiece is of hard rubber with a screen in the bottom to protect the diaphragm from injury. Figure 2 shows the appearance of the inside of the transmitter. In this view the heavy cast front is plainly shown. The cup for retaining the carbon granules is made in one piece with the bridge. It is drawn into the bridge under heavy pressure and then counter-bored, making each cup perfectly accurate in dimensions. Figure 3 shows the front side of the bridge. The front electrode is mounted upon a flexible diaphragm upon which it vibrates. This electrode is fastened to the transmitter diaphragm by means of a nut placed in the front and back of the diaphragm. The electrodes are made of specially prepared carbon disks polished to a brilliant gloss. They are large enough to permit sufficient current to flow so as to transmit conversation over long lines. Should it be necessary to talk over extra long lines, double the normal amount of battery may be used without harm. On account of its battery carrying capacity it is exceptionally valuable as a long distance instrument. The diaphragm is made from a special alloy of aluminum. This alloy gives it great resilience and quick action, so that in use it has that quick, sharp, clear articulation with a most perfect quality. A specially prepared granular carbon is used in all these transmitters. This carbon is extremely hard and possesses a very low resistance. All the granules are carefully re-screened so as to be all of uniform size. Because of the special granular carbon and the polished electrodes, the transmitter is entirely free from disagreeable packing, which in the past has been the bug-bear of the telephone user The finishing of this transmitter, both outside and inside is carefully done, so that it always is a workmanlike piece of apparatus. The front and rear are nickel plated, the diaphragm is satin finish and the bridge is treated with a special process which gives it a frosted effect. All parts of the transmitter are made accessible and also inter-changeable so any part may be replaced at any time. The Standard Telephone & Electric Company has recently gone to a great expense to install special machinery for the manufacture of this transmitter in order to be able to make it cheap enough to be sold at a reasonable price and also to be enabled to turn out a continuously good product. The company states that it has already received some very flattering reports on this transmitter and numerous orders for it.

FIG. 1.

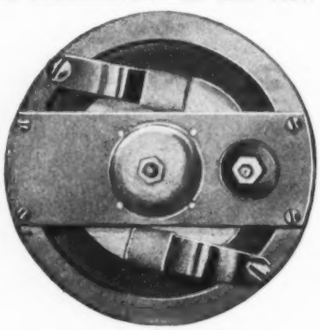


FIG. 2.

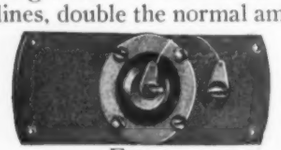


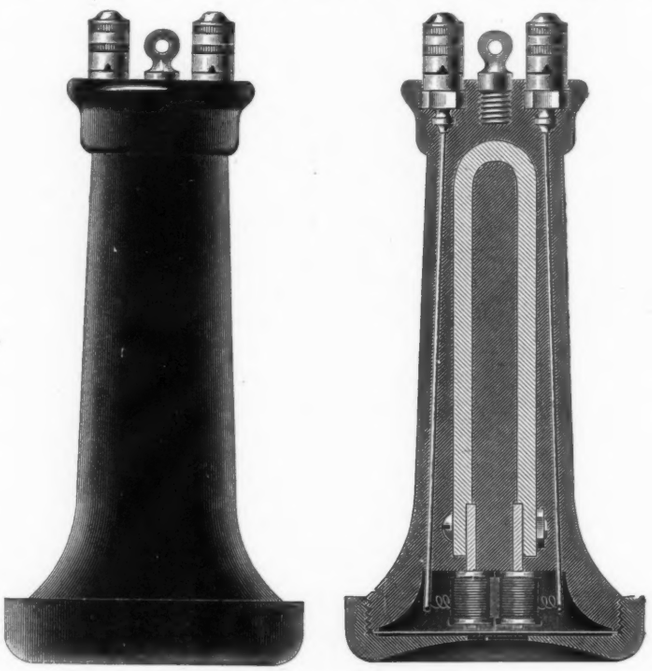
FIG. 3.

THE "SOLID" RECEIVER.

Telephone manufacturers have long desired a receiver that could endure the rough treatment generally given this particular instrument. In the familiar hollow shell instrument, they suffered constantly from the loosening of the parts, from the cracking of the case, and worse than all, from frequent changes of position of the diaphragm with relation to the pole pieces. This variation of distances made it impossible to secure the best results out of the receivers and was a constant source of complaint from the users.

In the "Solid" receivers these defects have been remedied and remedied effectively. The metal parts of the receiver are molded solidly into the case, making the instrument not only practically unbreakable but giving an adjustment that is absolutely unchangeable.

The "Solid" receivers are made in three styles. The first, style "C," a bi-polar pony receiver, with strong binding posts on the outside. In the second, style "E," the binding posts are dispensed with, and the connections are made with the cord, by small screws, which are covered by a cap that forms the end of the receiver. In this style of receiver it is impossible to receive a shock while using it, as no metal parts are exposed.



MURDOCK "SOLID" RECEIVER.

The "Solid" receiver made up in watch-case form, is also of the bi-polar type, having the cord connections on the inside.

Wm. J. Murdock & Co., Chelsea, Mass., manufacture the "Solid" receiver, and would be pleased to give further particulars about them.

"We have operators here if you wish them to send a message for you," said the manager of the telephone office; "or we have booths if you wish to telephone yourself."

"No, I don't want to telephone myself," said the lady. "I want to telephone a friend of mine.

FISK-NEWHALL TELEPHONE MANUFACTURING COMPANY FACTORY, CHICAGO, ILL.

PORTION OF MACHINE SHOP.

SECTION MACHINE DEPARTMENT.

GENERAL OFFICES.

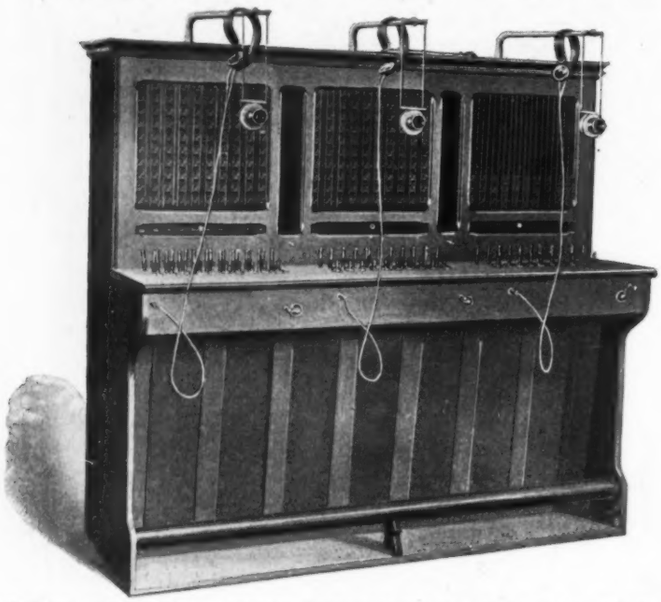
FRONT VIEW 300 DROP SWITCHBOARD.
SWITCHBOARD DEPARTMENT.

REAR VIEW 300 DROP SWITCHBOARD.
ASSEMBLING DEPARTMENT.

SULLIVAN TELEPHONE EXCHANGE.

The following cut illustrates the switchboard recently installed by the Sullivan Telephone Exchange Company, Sullivan, Ill., which has a capacity for three hundred subscribers' lines and is constructed to meet their special requirements.

This company began operation a few years ago with less



FRONT VIEW 300 CAPACITY SWITCHBOARD, SULLIVAN TELEPHONE EXCHANGE CO.

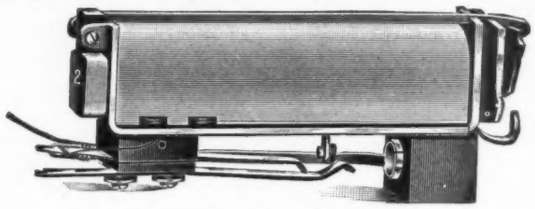
than one hundred subscribers. Under the able management of J. L. Kirk, this number was steadily increased until the two hundred mark was reached, and it became necessary to purchase a new switchboard with a capacity for three hundred lines. Owing to the more or less unsatisfactory results obtained from the old board, the company determined in making the selection of a new one, that price should not enter into the consideration and only genuine merit should be considered. On this basis it began to solicit prices and have samples submitted from all the prominent manufacturers of switchboards. All these samples were critically inspected and tested for mechanical as well as electrical efficiency, and the contract was awarded to the Western Electrical Supply Company of St. Louis.

The points considered most essential in the selection of this board were summed up, viz.: First, simplicity of construction; second, quality of material and workmanship; third, rapidity of operation; fourth, finish; fifth, accessibility.

That these are the most important points in the design and construction of a switchboard every practical telephone engineer will concede, and it goes without saying that the most expert talent could not have devised a better line of proceedure.

In one of the illustrations is shown a rear view of this switchboard which gives the reader an understanding of the manner in which the lines are terminated and the connections are made with the drop. Each drop and jack is combined and incorporated into one piece of apparatus, and so arranged that each combined drop and jack is self-contained in the cabinet enabling the removal of any one or more without in any way disturbing the operation of the rest or necessitating the unsoldering of any cable wires. Owing to the novel construction of this combined drop and jack, the shutter, which is made to fall indicating a call, is hinged on the inside so that when it falls it appears in an opening in view of the operator. The advantage that is claimed for this is that the face of the board is entirely smooth, there being no drop shutters or anything of that nature to project, and completely eliminates every possibility of mechanical injury, besides very materially improving the external appearance.

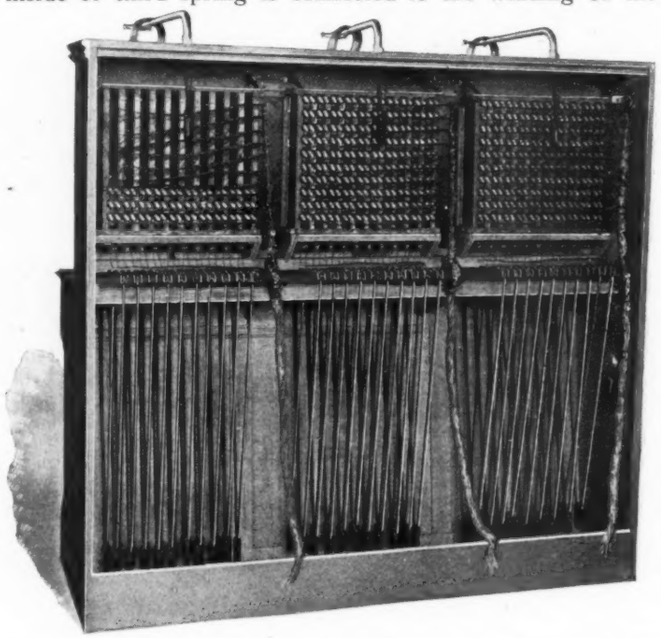
It is claimed that this is the only drop in use employing the novel and ingenious method of mounting the armature on the front end of the magnet coil where it is made to rest on a knife edge without the use of hinges. The adjustment of the armature is very close to the magnet coil and when it is considered that all friction has been eliminated, it is in a measure possible to appreciate how readily this drop may be actuated with the minimum amount of current. While this drop is constructed with a view to attaining the greatest possible electrical efficiency, an important point, that of designing the parts so as to prevent "Freezing," was not over-



COMBINED DROP AND JACK.

looked and it is claimed that freezing will not occur with 50 per cent over normal voltage.

In the illustration of drop and jack it will be seen that the jack consisting of two substantial German silver springs are mounted above the drop coil and form the contact screws in the rear of the board. The line wires being soldered permanently to clips through which the formed up jack springs pass and are held secure by the thumb nut. The inside or third spring is connected to the winding of the



REAR VIEW OF THE SULLIVAN TELEPHONE EXCHANGE CO.'S SWITCHBOARD.

magnet coil so that when the plug is inserted the coil is cut out of circuit. The act of inserting the plug also restores the drop shutter. This is accomplished by means of a single lever which engages the drop shutter when the plug is inserted and restores it to its restored position where it rests directly upon the armature itself.

It will be observed from the cut that the magnet coil is enclosed in a tube. This tube is genuine Norway iron, and as the coil connections are made on the inside there are no

frail wires exposed, the coil leads being connected with the jack springs by means of substantially German silver clips.

It is claimed that this switchboard possesses every up-to-date improvement found in other switchboards on the market, including a number of decided departures, a few of which are described above. It is requested by the manufacturer that parties who are in the market or are interested in magnetic switchboards communicate with the Western Electrical Supply Company, St. Louis, Mo., and thoroughly familiarize themselves with this new switchboard before making their selection.

The Western Electrical Supply Company announces that the short time it has had this switchboard on the market the company has been overrun with orders and the cuts herewith illustrate one of a large number of boards that they have turned out ranging in size from one to six hundred numbers, and it is claimed that there is no limit to the capacity of an exchange to which this board would be adapted and that it is made with a flash light transfer system or full multiple.

CENTRAL ENERGY TELEPHONES FOR MINES & INTERURBAN RAILWAYS.

A new central energy mine and railway set which is especially designed to meet the conditions of bad weather, hard usage and places where high potential currents abound, is shown in figures 1 and 2. This outfit is made by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., and Rochester, N. Y. The iron box which protects the telephone proper, is claimed to be weatherproof and absolutely water-tight. The line connections are brought into the box through a double elbow, at the top, as shown, thus eliminating any chance of water coming

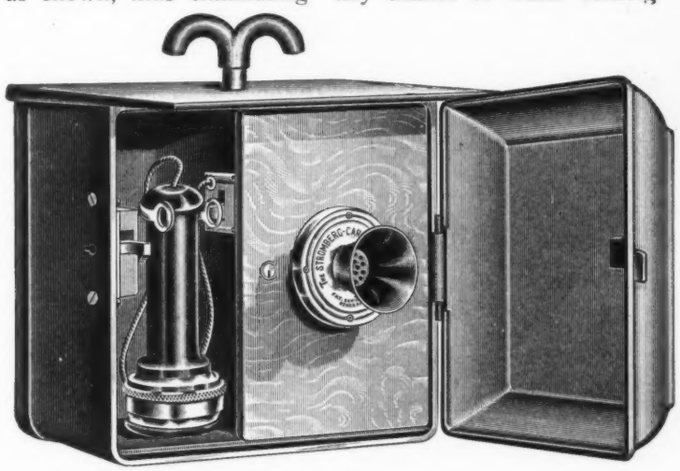


FIG. 1.

in contact with any connections in the box. The mechanism is completely protected by the inner case, which is locked and only accessible to the person having charge of the maintenance of the system. The various parts of the apparatus are mounted on the inside of the inner case door, and when it is open, reveals all parts in a manner that is convenient for inspection, test or repairs. The equipment of a single telephone consists of one S-C long-distance transmitter, one S-C bi-polar receiver, platinum contact hook switch, metallic carbon and fuse lightning arrestor connectors and all necessary parts, for the complete operation of a central energy system. All metal parts are non-corrosive and all circuits are wired with the best grade of rubber insulated wire. All parts are interchangeable.

The Line Cut-Out.—This device is provided when specified and is intended as an absolute line disconnector, when the receiver is hung on the switch-hook and the outer case door closed. This makes it impossible for any high potential current arcing to take place in the case when the apparatus is not in use; the carbon and fuse arrester being permanently connected to out-going lines.

FIG. 2.

That part of the equipment, shown in figure 3, is known as the cut-in station and is intended for use in connection with the instruments already described. This box is weatherproof, provided with hinges and lock and made of heavy cast iron. It is so constructed that it may be used without unlocking. In the lower end of the box an opening is provided with a self-closing trap door, which may be opened by pressing upwards. This equipment consists of a bridging jack with heavy german silver reinforced springs and mounted on a heavy hard rubber base and with heavy sleeve for plug guide, the tension of the springs being sufficiently strong to retain the plug firmly in position and assuring perfect electrical contact. On the bottom of the box there is a "Y" shaped guide or groove which forms a path for plug, to the opening in spring jack sleeve, thus making it convenient for the user to insert plug into the jack. The mere insertion of the plug calls the dispatching operator or headquarters.

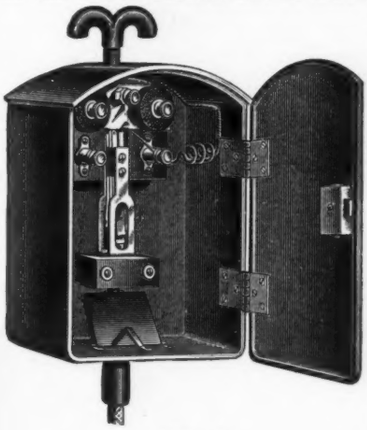


FIG. 3.

This instrument bids fair to become a very popular one with street railway people, and it is understood that the above company has a number of contracts already executed for this line of apparatus.

CHINESE TELEPHONE GIRLS.

While it is true that the Chinese, as a race, are opposed to new ideas and new inventions, it is equally true that the Chinese in this country are not by any means slow to recognize the merits of new discoveries and a singular proof of this fact is that Chinese girls are being employed in San Francisco as telephone operators.

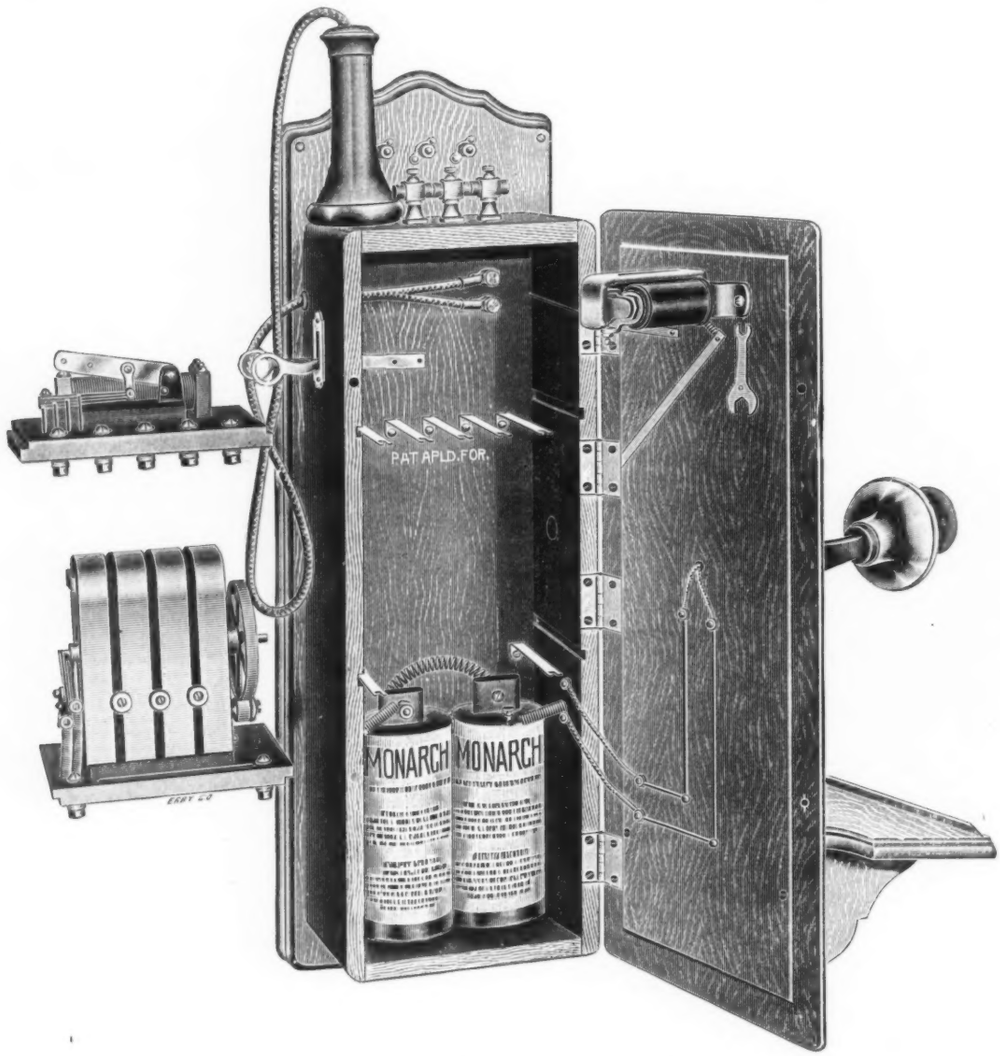
In that city there is a large and prosperous Chinese colony, and the well-to-do business men who are members of it find that the telephone is as indispensable to them as it is to American business men. They could not use it very effectively, however, if they were obliged to talk to persons ignorant of their language, and that is why many Chinese girls are now employed at the telephone.

This work, so novel to them, they learn rapidly and

well; indeed, the experiment has proved so successful that the number of girls who are thus employed is being constantly increased.

MONARCH DRY BATTERY COMPACT TELEPHONE.

The Monarch Telephone Manufacturing Company, Chicago, has recently put on the market a dry battery compact type of telephone which has a number of unique and valuable improvements in its details of construction and design. In this instrument all the working parts are mounted in the well-known single box style of cabinet, but in such a way that they can be quickly removed for inspection or rapairs without in any way disturbing the permanent wiring of the instrument. This advantage will be readily appreciated by practical telephone men who are familiar with the annoyance and trouble of repairing the parts of a telephone where they are located in the extreme back of the box and have their terminals soldered.



MONARCH DRY BATTERY COMPACT TELEPHONE.

In the Monarch instrument, illustrated on this page, the generator, switch and induction coil are mounted on shelves which occupy the usual position in the cabinet, but instead of being wired permanently through the back of the box the connections are made to double lock-nut terminals situated near the front edge of the shelves and arranged so as to engage the slotted connecting strips that extend out from the back of the cabinet. These connecting strips are attached to the back board by means of a wood screw and have projections extending through the wood, to which the back wiring is soldered. The front end of the strips are provided with U-shaped openings so that it is necessary simply to loosen the lock-nuts, by means of the wrench which is provided with each instrument, to remove either of the shelves, together with the important parts mounted on them. These shelves are made of five-ply hardwood to prevent them from warping or springing and to insure easy removal when so desired. The tightening of the hexagon lock-nuts serves the double purpose of making a positive connection and at the same time locking the shelves firmly in place.

These instruments are made up entirely from Monarch parts, which have earned a wide reputation for efficiency and durability, and are supplied with three, four or five bar generators for either series or bridging work, also for direct current, divided circuits or with direct pulsating current for use with "biased" bells.

The company has long been an important factor in the telephone parts business, and in placing its complete instrument on the market it will pursue the same general business policy of making prompt deliveries and fully guaranteeing all its products.

A NEW MANUFACTURING CONCERN.

The Mountain State Electrical Company, Wheeling, W. Va., has entered the manufacturing field with a new cable box, designed by Frank B. Hall, one of the inventors of the Selectaphone. Mr. Hall has had a wide experience as a construction engineer, having been connected with the construction department of the Bell company for seventeen years. Upon entering the Independent field he found room for improvement in construction methods and set to work to design specialties to meet the requirements of this class of trade.

The result has been a line of special hardware for aerial and underground cable work, and a line of neat, durable and efficient cable boxes which are made in two styles and all sizes. For underground work the boxes are designed to be placed on pole top with a distributing ring forty-eight inches in diameter and made of ½x2-inch galvanized iron, which is attached to the pole with two pieces of gas pipe passing through holes bored through the pole horizontally in the shape of a cross—one piece of pipe being bolted to the top of the ring and the other on the under side.

Subscribers' drop wires are attached to porcelain insulators that are bolted, one on the top and the other on

the under side of the ring with ⅜-inch machine bolts. This makes one of the neatest, cheapest and most substantial methods of distribution on the market. Aerial cable boxes are mounted on iron brackets and bolted to the side of pole. Subscribers' drop wires are attached to small stamped steel brackets accommodating two pair of wires to the bracket.

All boxes are provided with efficient lightning protection, the brass parts being mounted on hard rubber bases and are furnished with galvanized iron covers making them waterproof.

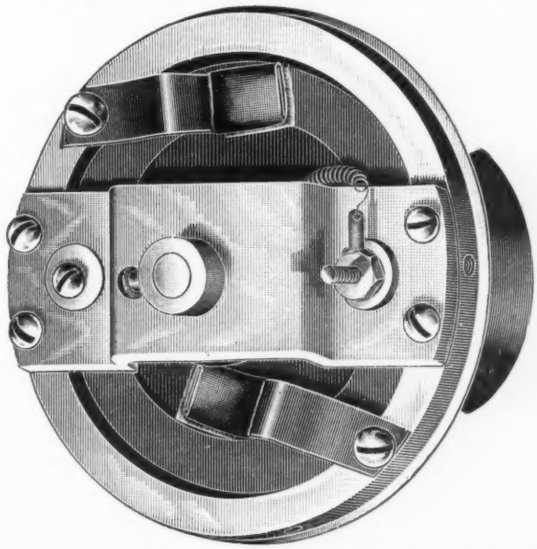
The company has prepared an attractive book entitled "Telephone Cables," illustrating and describing some late methods in cable construction, which will be furnished upon application.

The National Telephone Company's main and sub-exchanges at Wheeling, W. Va., are equipped in full with the line of specialties manufactured by the company, and these exchanges, which are cable throughout, are distributed on the multiple tap system and are said by experts to be the best constructed in the country.

Among recent large orders received is one for the Dayton Home Telephone Company of Dayton, O. The company intends to have a representative at the convention for the purpose of bringing its product before the telephone public.

THE HIPWELL TRANSMITTER.

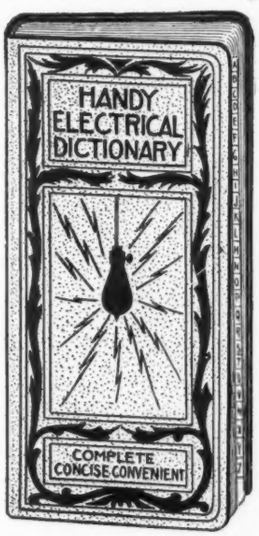
The Hipwell Manufacturing Company, Allegheny, Pa., is offering the trade its new transmitter, as shown in the illustrations herewith. The company claims that this transmitter is superior in every way to the Bell transmitter. It is made of heavy casting throughout, the electrodes and granular carbon are mechanically sealed in the metallic carbon chambers and cannot be changed after it is perfectly adjusted. The chamber holding the carbon is fastened securely to the diaphragm and the vibrations of the diaphragm have a tendency to shake up the carbon, which entirely eliminates the possibility of packing. The



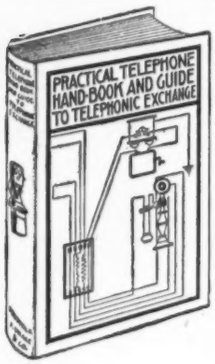
diaphragm is delicately pivoted by the dampening springs and has a pendulum movement which gives double the amplitude that is obtained by the former methods of holding diaphragms. This transmitter is constructed on the duplicate or interchangeable system and the manufacturers claim it is good for a lifetime of service.

THREE NEW BOOKS.

The Telephony Publishing Company has added three new books to its list of telephone publications, which ought to prove very acceptable to those interested in the art. The "Handy Electrical Dictionary," compiled and edited by W. L. Weber, M. E., is a practical handbook of reference, containing definitions of every used electrical term or phrase. The volume is alphabetically arranged and is issued in vest pocket form in cloth at 25 cents and in full morocco and gold at 50 cents. Every practical electrician feels the need of a book of ready reference and there is not one among those in the highest ranks of scientific knowledge who is not sometimes confronted with situations temporarily perplexing at least, if not insurmountable, and which might be promptly relieved if he had ready access to the authoritative guidance which is given or implicitly contained in this little vest pocket dictionary.



"The Practical Telephone Hand-Book and Guide to Telephonic Exchange," compiled and edited by T. S. Baldwin, M. A., is profusely illustrated and contains chapters on the use of the telephone, series and bridging telephones, line construction, material to be used and location and correction of faults in instruments and lines, the apparatus and methods used in making all of the tests required in construction telephone work, including the exchange, are fully and carefully treated, and in addition plain, easy instructions on farm telephones, which are of inestimable value to promoters of rural lines. Price, $1.25.



* * *

"Manual of Telephony," by J. A. Williams, illustrated, price $1.00. As its name implies, this book is intended as an elementary and practical treatise on rural telephony. Its object is to enumerate and explain all of the many points to be considered in connection with the organization, construction, operation and maintenance of private lines, party lines and rural telephone exchange systems. This volume ought to be of great value to those contemplating the organization of new companies. A chapter is devoted to this subject and is subdivided as follows: Constitution for Telephone Association; By-Laws for Telephone Association; Form of Articles of Incorporation for a Telephone Company; Form of Acknowledgement of Articles of Incorporation; Form of Subscriptions to Capital Stock; Form of Certificate of Stock; Form of Constitution and By-Laws; Form for Amendments; Various Forms for Minutes for Corporation Meetings, Stockholders' Meetings, Directors' Meetings, etc., with comments on the different forms of organization.

"ADVANCE" MAGNETO AND SWITCHHOOK.

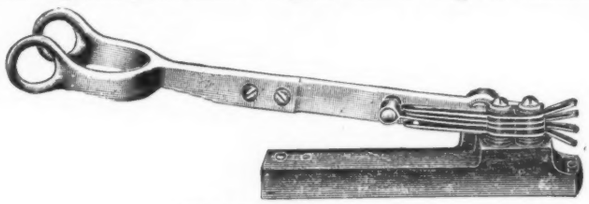
The accompanying illustrations represent the new magneto that the Advance Electric & Telephone Company, Chicago, has recently put on the market. Many durable and desirable changes have been made in the generator (which

ADVANCE MAGNETO.

was recently described in TELEPHONY), are shown, as well as a switchhook, which is decidedly clean and novel in design and a remarkably strong contact maker. The top and bottom contact springs of this switchhook are very heavy, indeed so strong that they constitute adjustable stops so that the entire pressure of mainspring or receiver are expended against these stops which are the contact. This pressure at contact point represents two and one-half pounds. This is a performance claimed never to have been approached. The main spring, which is of heavy flat German silver, has been located in the base, so there are no deformed mainsprings to disfigure the interior of the telephone.

The ringer has also been improved. An exceptionally strong formed base has been added, which prevents any bending and consequent displacement of adjustment.

The lightning arrester is a gem, and is of great efficiency,



ADVANCE SWITCHHOOK.

the line plates being very large. The company has departed from the common error of making an arrester all ground plate and very little line plate.

The entire magneto has the appearance of mechanical and electrical perfection which should highly commend it to the trade.

DE VEAU TELEPHONES.

The accompanying illustration shows the new type long-distance desk set just placed on the market by the DeVeau Telephone Manufacturing Company of New York. This

STANDARD NICKEL DESK TYPE.

telephone, both for handsome appearance and fineness of construction, will recommend itself to all those who appreciate good material in telephone equipment. The Bell type transmitter and receiver are constructed for either common-battery or magneto circuits. Another instrument is made much on the same order as this, but designed for the well-known DeVeau switchless automatic systems for use on intercommunicating work. This latter system, best shown by illustration, does away with the old-fashioned switch which had to be brought back to the home point when the conversation was finished. In place of this the operator uses push buttons which are located in the base of the instrument. These buttons when depressed to make a connection, stay down until the conversation is

finished, when the hanging up of the receiver releases the mechanism and they return to zero. These telephones are supplied in two styles of wall sets in addition to the desk set just described. One of these is a very handsome "flush" type for high class residence work, where it is desirable to have the telephone sunk in the wall so that only

DEVEAU PORTABLE HOME TELEPHONE OUTFIT, WITH HAND MICROPHONE AND PLUG ATTACHMENT.

the circular nickel-plated front plate which carries the button, transmitter, etc., is visible.

The DeVeau Telephone Manufacturing Company has also on the market a complete line of switchboard and long distance apparatus, both for the common-battery and magneto service, which is of such high order as to recommend itself to all customers desiring good design and careful, thorough workmanship.

THE SAVING OF $20,000,000 A YEAR.

In some interesting figures on the growth of the use of the telephone in the United States in a recent editorial in TELEPHONY entitled "Golden Opportunities for Earnest Workers," it is stated that at the end of the present year (1902) there are 6,511 telephone exchanges, of which 2,811 are Bell and 3,700 Independent, operating 2,350,000 telephones, of which 1,500,000 are Bell and 1,350,000 Independent, and requiring the services of 79,436 persons, of which the Bell companies employ 40,864 and the Independent 38,572.

What would be the labor-saving effect of the substitution of machine operating for hand labor in the communication traffic expressed by such figures? It is worth while to examine into the mere saving of the wages of the hand operatives employed at these switchboards, leaving out of consideration entirely the collateral advantages of the substitution of a machine to handle such a traffic.

It is fair to assume that at least 60 per cent of the above total number of employes are "operators"; that means 47,662 persons sitting at the boards making connections and disconnections—a purely mechanical task that belongs by right to a machine, when the traffic reaches the figures indicated by 7,531,761 daily calls for Bell companies alone during the year 1901. Add to this number of operators at "Central" the total of 15,000 branch exchange operators made necessary at the offices of large business houses by the inefficiency of present hand-operated exchanges, and we have, roughly, over 62,500 employes who would be better employed elsewhere.

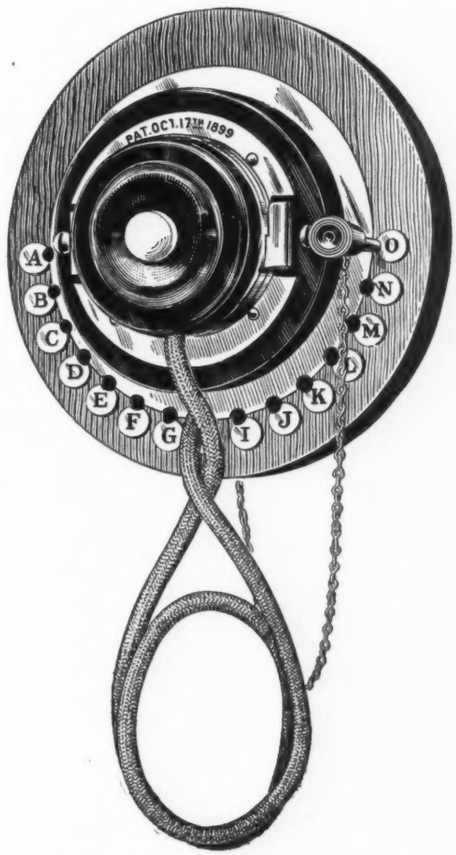
To allow for the number of long distance operators that would still have to be retained and for the number of branch exchange operators that would still be retained in very large establishments for supervision and checking of toll connections, we may call the number of hand operators capable of being displaced by an efficient machine at "Central" approximately 57,500. At the low yearly wage of $350 we have $20,125,000 annually spent for services that should be better employed than in limiting by hand labor the speed of communication of the electric telephone.

The stupendous figure of 2,240,000,000 telephone calls made through Bell exchanges alone for the year 1901 indicates a communication traffic to continue to handle which by hand labor in the presence of automatic machines already successfully applied for the purpose would be to hamper the march of progress in this important department of modern industrial life.

Quick telephone service means instantaneous operating at all times; and that cannot be given by the use of hand labor under present and future conditions of heavy and irregularly distributed traffic. VINTON A. SEARS.

PUSH BUTTON TELEPHONES.

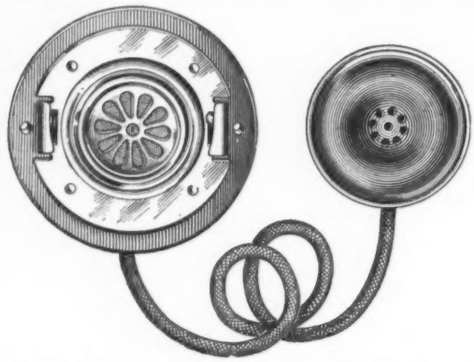
The Commercial Electrical Supply Company, St. Louis, Mo., reports its inability to attend the convention, due to the fact that the company is behind in all departments, having



THE PUSH BUTTON TELEPHONE.

made a number of heavy shipments the past month. It reports a special show of appreciation from customers who have experienced its "hurry-up" ability. The push-button telephone illustrated herewith and adapted for intercom-

munication switchboard and straight line work is having a considerable run with this company, installed for extensions and private systems in connection with exchanges. This



RECEIVER REMOVED, SHOWING TRANSMITTER.

telephone in size and appearance resembles an ordinary push button and when not required for speaking can be used as such. Where electric bells are already fitted the push buttons can be removed and the new instrument substituted in a few minutes without disturbing the existing wires, indicator bells or batteries. Each instrument consists of two parts, the receiver and the transmitter, connected by a flexible conductor. The base of the transmitter is fixed in place of the bell push; the receiver carrying the push button rests in front of the transmitter. In this position the resemblance to an ordinary push button is very close. For interior installation in private houses, hotels, factories and any building where it is necessary to communicate quickly with the various departments this device can be readily installed and commends itself by reason of its small size and economy of installation. Its efficiency as a means of communication over long distances has been successfully demonstrated,and while not much larger than an ordinary push button, it is claimed that conversations through it are heard more distinctly than over the large instruments now in general use. These telephones can be furnished in a number of wood finishes and compositions, conforming with any interior decorations. Descriptive catalogue showing the midget intercommunicating device will be sent upon application to the company.

SIDE VIEW.

A FRENCHMAN'S VISUAL TELEPHONE.

A new discovery of apparently remarkable value has been submitted to the French Academy of Sciences. It relates to the possibility of seeing the reflection of persons to whom one is talking through the telephone.

It is not possible, says the secretary of the academy, to pronounce upon the real value of the discovery at this early stage, but it has been submitted to the examination of a technical committee. The information publicly given on the subject is that a fresh contribution on the solution of the problem of vision through obstacles has been submitted to the academy by an inventor whose name would only be made known after the report of the committee on the practicability of the invention.

The inventor proposes to solve the problem by means of electricity, and suggests the utilization of the known electrical response of selenium to the action of light.

It may be mentioned that it is known that several persons are working at the solution of this problem of vision through the telephone.

AN ILLUSTRATION OF GROWTH.

The remarkable growth of the Independent telephone service in southern Indiana was shown in reports read at Louisville at the meeting of the Independent Telephone Association of Southern Indiana. The occasion was the joint annual convention of the southern Indiana and Kentucky state associations. The first Independent telephone system in southern Indiana was installed at Huntingburg, Dubois county. It was a co-partnership and had only forty subscribers, who had in mind only the thought of promoting their own business welfare and had no idea of serving the general public. This system, in a few years, has grown until it includes Knoxville, Bird's-Eye, Jasper, Haysville and Ferdinand and practically radiates telephone lines all over Dubois county. The Independent Telephone Association of Southern Indiana was organized three years ago at Huntingburg. There were only nine companies in the charter organization. To-day the association includes twenty-four separate companies which have on the average 500 subscribers each. A first-class metallic line is now being built to connect Louisville with Huntingburg, Princeton and Evansville and another line will soon be in operation to Indianapolis. This means that within a few weeks all of the southern Indiana Independent exchanges will have long distance communication with the north and northwest by way of Indianapolis and with the south and east via Louisville. The tendency of Independent telephone development in southern Indiana is to consolidate the small lines in a county into one county exchange. The days when a farmer puts up a line to the houses of half a dozen neighbors and owns it himself are about past, as such lines are being merged rapidly into the county exchanges. In fact, the twenty-five companies now belonging to the Independent Telephone Association of Southern Indiana practically represent that many county exchanges.

M. COMBES' TELEPHONE.

M. Combes, the prime minister of Paris, is having a very bad time of it with the telephone girls. The prime minister accuses them of curiosity. He says they have listened to state secrets. But he stops short at charging them with repeating what they've heard. Probably he thinks it will be understood that a telephone girl could not keep a state or any other secret. There has been an awful row over the business, and the young ladies have been banished from the telephone while M. le Ministre holds converse with his friends or colleagues. Still, M. Combes is not happy. For a prime minister he seems to have plenty of time to devote to little worries. He next found out that the young ladies did not reply to his calls with sufficient alacrity. Any ordinary individual who suffered in this way would swear to himself—because swearing in the telephone is universally forbidden—and calculate how much quicker he might have done his business had he resorted to a penny bus. Fearing that the annoyance of waiting for the telephone would be too much on top of the surprises, the telephone company provides, whenever M. Combes is speaking, the director of telephones put a special inspector on duty over the disc of the premier's telephone and a report is sent to the ministry of the interior in this style:

11:32—Signal from premier's office fell.
11:32.7—We are on the line.
11:32:43—M. le Ministre's communication established.

The longest telephone cable in the world has been constructed and now connects Love Point, Kent Island, on the eastern shore and Sandy Point on the western shore, crossing Chesapeake Bay. This cable is four and one-eighth miles long, contains ten wires and in telephone practice is known as armour proof. fff

A MODERN SYSTEM OF TELEPHONE PROTECTION.

FRANK B. COOK.

In the early days of the telephone industry, it was classed with the telegraphic art and the construction was done by telegraph construction men; as much of the apparatus and material entering into a construction plant was the same as used in telegraph work. This was especially true of protectors, and as the only thing to be guarded against at that

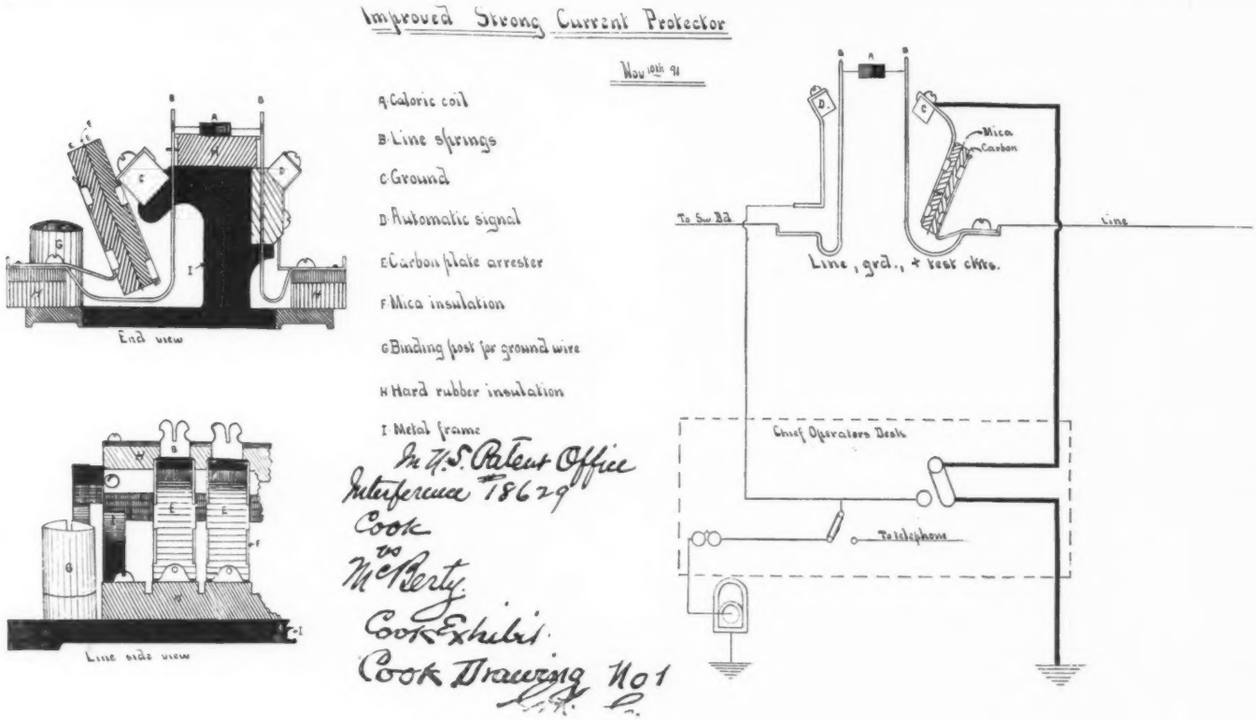


FIG. I.

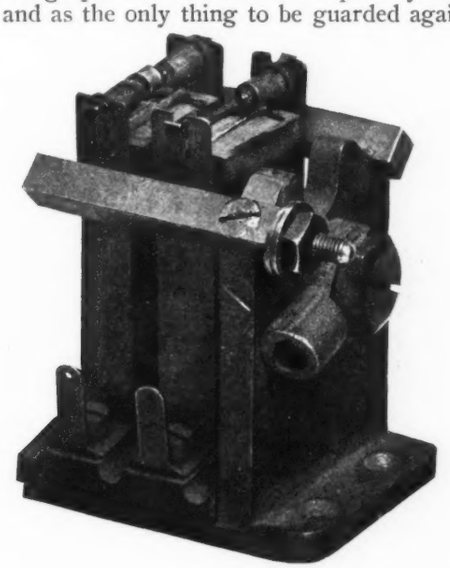


FIG. 2.

time was lightning, the arresters generally used were metal plates separated by an air gap or by a piece of paraffine paper. When the aerial cable was introduced into telephone work this style of arrester was found to be anything but efficient and the next step in the direction of improved protection against the disruptive discharge of lightning was the introduction of the arrester made by taking a few turns of fine, insulated wire around a rod, which in turn was grounded. These forms of lightning arresters answered the purpose fairly well, although not to be compared to the present carbon plate arrester separated by a silk or perforated mica diaelectric.

With the advent of the electric light and power plants the

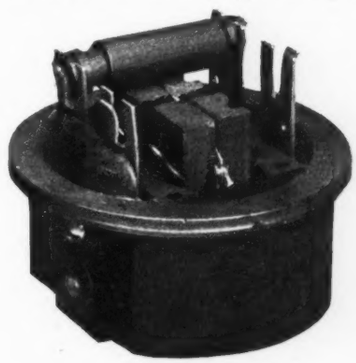


FIG. 3.

trouble man's difficulties increased at an alarming rate, but the real trouble was not encountered until the deadly trolley lines put in their appearance, when most exchanges found it necessary to keep a man on watch day and night. Indeed, previous to this, many telephone plants which had practically no protection whatever against lightning, found it necessary to provide against these foreign currents, and in spite of their utmost endeavors, burn-outs from crosses with

these lines were frequent, and expensive, the telephone being the one in all instances to suffer injury.

Having charge of the reconstruction of many burned-out exchange towers and switchboards, and frequently working from twenty-four to thirty-six hours without rest in order to restore service, gave serious thought to the question of adequate protection for telephone systems. This was a question in which many were deeply interested and there were frequent meetings to discuss these matters, which finally culminated in what are known as the "conference specifications," which are as follows:

1. Must operate with a current of 0.25 of an ampere within one hundred and fifty (150) minutes.

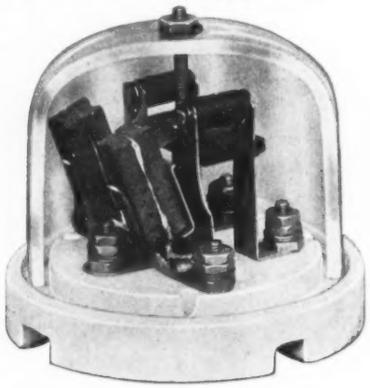
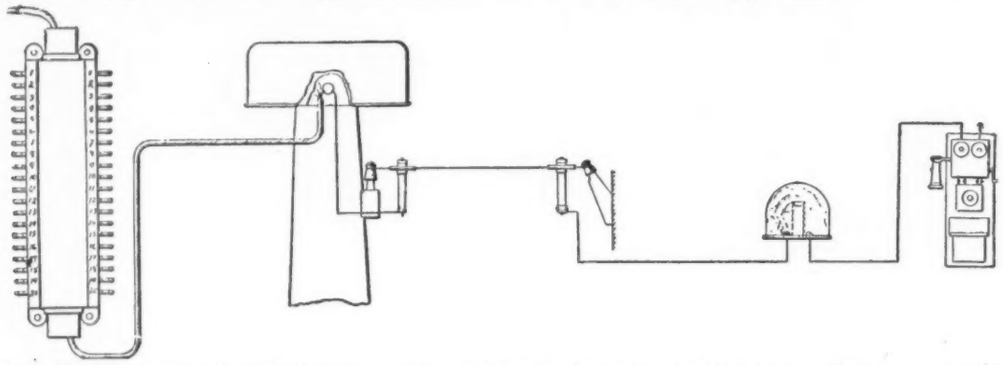


FIG. 5.

2. Must operate practically instantly with a current of 2.5 amperes, or more.
3. Must not be destroyed by ordinary lightning discharges.
4. Must possess no self-induction.
5. Must operate equally well on grounded or metallic circuits.
6. Must prevent abnormal charges of high potential on metallic circuits.

FIG. 6.

7. Must not be operated by telephone or generator currents.
8. Must be so arranged that there can be no possibility of the formation and continuance of an arc.
9. Must be so arranged that it can be connected quickly and firmly with the line.
10. Must be made of material which is unaffected by heat or atmospheric conditions.
11. Must have no loose or double contacts whatever.
12. Must not be destroyed when operated.
13. Must protect telephone and transmitter as well as bells and annunciator.
14. Must protect office wire, cables and switchboards, as well as other apparatus.



Cook System of Complete Protection. Patented May 20, 1890; Jan. 16, 1900; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902; Aug. 12, 1902; Oct. 21, 1902.

FIG. 4.

Previous to the adoption of these conference specifications there had been a considerable number of protectors devised and some used, in which an electro-magnet was used either to open the line circuit or ground it when the magnet was transversed by a current stronger than normal, the introduction of an electro-magnet in the telephone circuit being detrimental to good service, was not looked upon with favor by engineers, and comparatively few of them were put into service.

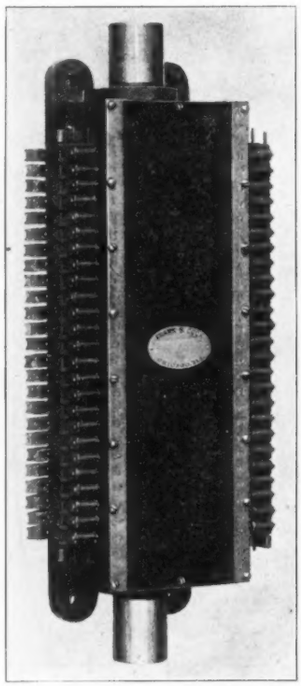


FIG. 7.

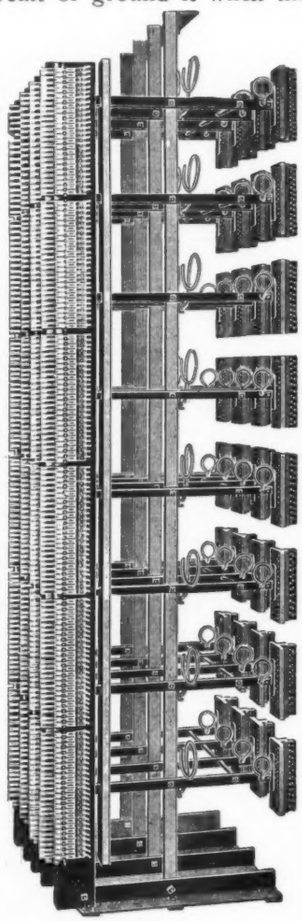


FIG. 10.

My first efforts towards an improved protective system

was about the year 1886, and from that time forward I made numerous experiments and practical tests, but as my attention was divided with inventions and improvements along other lines, I did not make much progress until about 1888 or 1889, at which time several serious losses due to inadequate protection caused me to give greater attention to the subject. I made up numerous forms, samples of

FIG. 8.

which have not been preserved, but did not feel altogether satisfied with the results. Between the years of 1888 and 1892 I designed the circuits and apparatus shown in Fig. 1, the particular type illustrated being intended for central office use. The type shown in Fig. 2 is a modification of the same principle and consists of carbon-plate arresters and heat coils, mounted very compactly in a glass covered case, the metal base of the case being designed to set into the

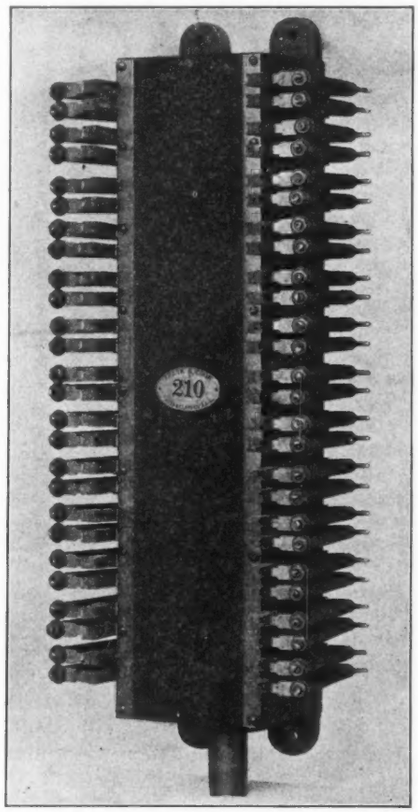


FIG. 9.

woodwork of the magneto bell, or back-board. The glass cover is not shown but the cut is a full size reproduction. The type shown in Fig. 3 consists of a pair of carbon plates mounted between the line springs, and the line springs connected together by a heat coil placed above the carbon plate. The illustration is full size and very compact, and was designed for central office use. These three types of protectors did not go into general use, although some of them were made up and sent to various parts of the country and put to very severe tests.

Between the years 1893 and 1896 I designed the complete protective system and circuit arrangement as shown in Fig. 4, and large quantities of the apparatus was manufactured and put into use. This complete system consists of the glass covered protector for the subscribers' station shown in Fig. 5, the tubular line fuse shown in Fig. 6, and a combined cable terminal and protector as shown in Fig. 7. As time went on, and experience proved that this system of protection could be depended upon to protect (there being no cases of failure) and having received the approval of the Electrical Bureau of the National Board of Fire Underwriters, the system of protection commonly known as the "Cook system" was adopted and recommended by many engineers, as a standard. Some idea of the extent to which this apparatus is used may be gathered from the fact that the Chicago Telephone Company alone have used over 10,000 of the protectors as shown in Fig. 5. and about 100,000 of the tubular line fuses as shown in Fig. 6, and large quantities of these protectors have been used by many other Bell exchanges.

The tubular fuse protector shown in Fig. 6 is designed to be clamped directly upon the line wire at the insulator, and the bridle wire to be connected to the other end of the fuse, the fuse serving as a means to connect the bridle to the line wire. Some engineers prefer to use the pole house with either lock-nut terminals or pot-heads, and for mounting in these pole houses I designed the type shown in Fig. 8. The particular type shown is mounted with carbon-plate arresters, and I also designed another type for those who might prefer to use the tubular fuse only, without the carbon-plate arrester. The manner in which these are mounted in the cable box is very unique. To obviate the use of the short jumper wire required to connect the lock-nut terminal with the mounted line fuses I designed the type as shown in Fig. 9, in which the fuses are mounted directly upon the sides of the cable terminal, the terminal, of course, being placed in a cable house upon the pole.

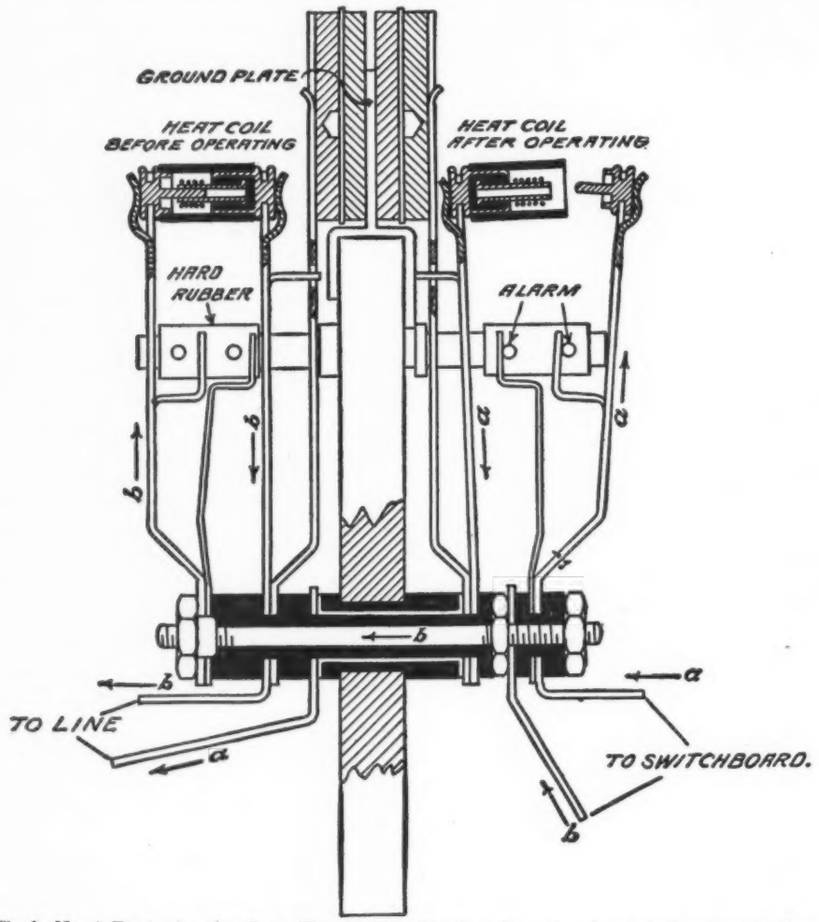
To economize space at the central office and at the same time provide a distributing board, I devised the type as shown in Fig. 10. In this the protectors, construction of which is shown in detail in Fig. 11, are mounted upon a cold-drawn steel bar in vertical rows, while the line terminal blocks, shown in Fig. 12 mounted upon the ends of the cross-bars, form either a horizontal or vertical row, the cross-bars forming a shelf or support for the jumper wires used in cross-connecting between the protectors and the line terminals.

All of the apparatus illustrated in the several figures is fully covered by United States letters patent, and a brief history of the patents may not be uninteresting. On January 2, 1892, I was convinced, rather against my will, to sign a contract giving the Bell Telephone Company an option on any invention that I might make while in their employ. On July 2, 1892, I submitted ten (10) inventions, including my protective system, for acceptance under my contract. On November 7, 1892, eight (8) of the inventions, including the protectors, were accepted by the company and I was advised to hold myself in readiness to take the matter up with their patent attorney. Time ran along for a year or more with nothing being done in the matter, when the letter of November 7, 1892, was recalled, and after another year or so I was advised to again submit the inventions covering my protective system, which was done under date of January 7, 1895, and on January 28 of the same year, in a written communication signed by the general solicitor, my inventions covering the protective system were declined. There were several written communications between the company and myself before I got their consent to file applications for patents in my own behalf

for any inventions which they had rejected, but finally securing this permission in writing, in July, 1896, I filed application for patent covering the system. After this there were several actions by the patent office, and the following April my application was put in interference with patent No. 504,368, dated August 13, 1895, which patent was assigned by the inventor, Frank R. McBerty, to the Western Electric Company. The case was bitterly contested by the Western Electric Company and every effort was made to deprive me of my invention. However, under date of December 12, 1898, judgment of priority of invention was awarded me, the court holding that I was not to blame for the long delay in filing my application and that I had not abandoned my invention. The Western Electric Company appealed from this decision, and on March 7, 1899, another decision was rendered in my favor which affirmed the previous decision of December 12, 1898. Immediately after this the case was again appealed by the Western Electric Company, and on May 12, 1899, a third decision in my favor was rendered, affirming the two previous decisions. Another appeal was immediately taken, this time to the highest tribunal before which the case could be brought—namely, the United States Court of Appeals for the District of Columbia. On February 13, 1900, Mr. Justice Shepard rendered the decision of the court, from which I will quote a few extracts.

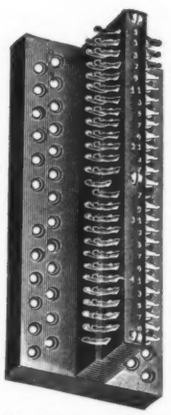
"The contest for priority of this invention, as is defined in the issue aforesaid, has been decided in favor of the appellee, Cook, by each tribunal of the patent office in succession. . . . The evidence so plainly supports the conclusions of these tribunals and has been so thoroughly discussed in their decisions that it would be idle to review it here. McBerty conceived his invention in June, 1893. Cook conceived his invention in 1891. . . . This brings us to the last, or fifth, proposition in the case important to be discussed. Here again we cannot agree with the appellant. In our opinion, the delay of Cook in applying for a patent or in making commercial use of his invention, was not such as to indicate an intention to suppress or conceal his invention from the public that would subordinate his right to that of McBerty. . . . Delay is often a potent circumstance in the aid of the determination, in the case not otherwise clear, of the question whether the invention had been successfully reduced to practice or had resulted in nothing more than an abandoned experiment. That point did not occur in the case at bar, because, as stated in the beginning, the evidence of actual and successful reduction to practice is ample. . . . The decision appealed from will be affirmed, and this result certified to the commissioner of patents in accordance with law. It is so ordered."

This long struggle with powerful corporations has not been without its reward, and after almost an endless amount of litigation and trouble I have at last been granted the patents covering my protective system, although more than eleven years has elapsed after the inventions were made before the patents were issued to me, but I have the consolation of knowing that they will be in force and protect my rights until the year 1919.



Cook No. 4 Protector for Iron Frame Distributing Board. Patented May 20, 1890; July 8, 1902; Aug. 12, 1902; Aug. 12, 1902.

FIG. 11.



Line Terminal Block

FIG. 12.

Your paper grows more interesting with each successive number.—FRED. BRUCE HORN.